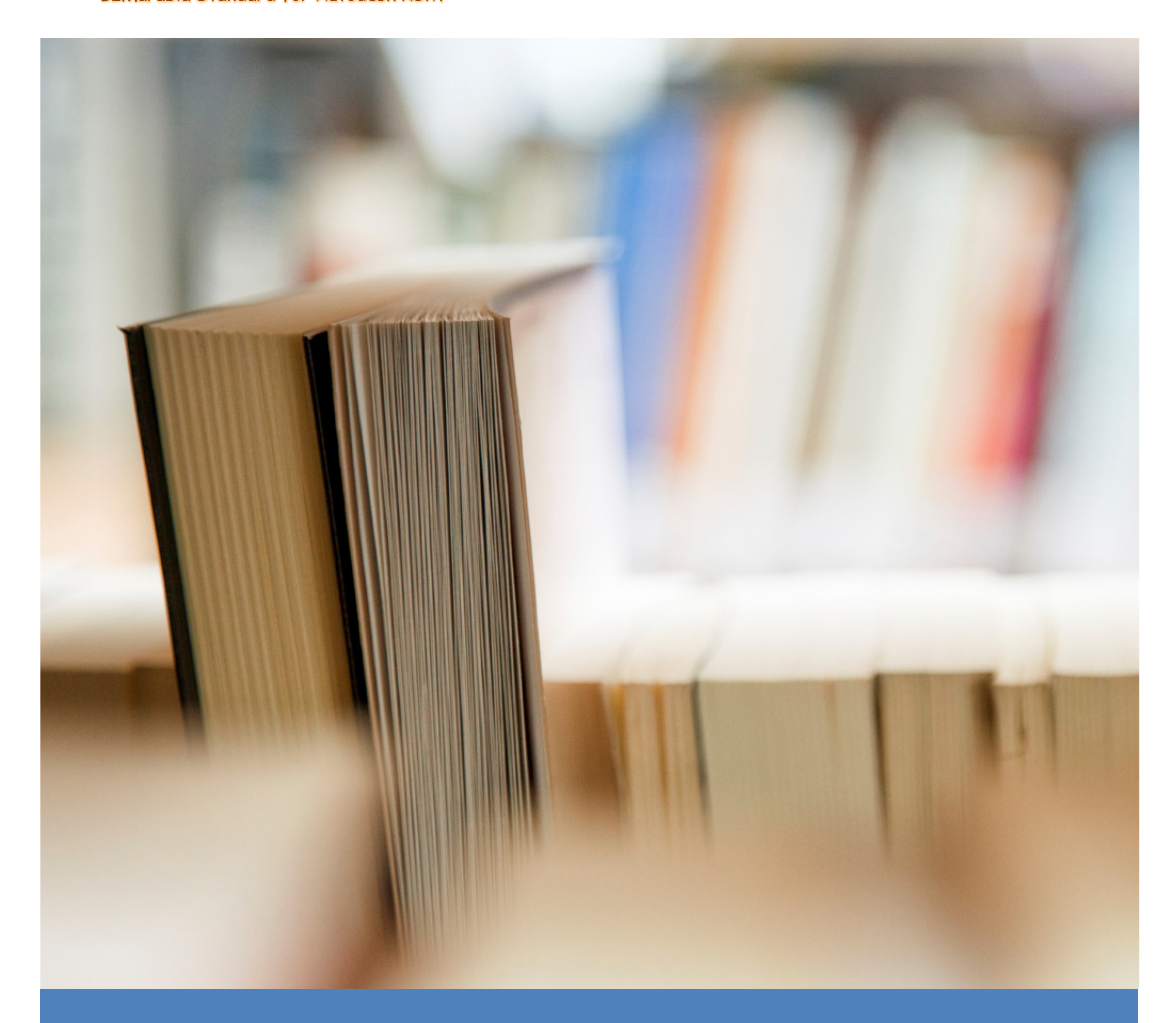


BIMarabia Standard for Autodesk Revit

A workable implementation of the BIM Standard for the Architectural, Engineering and Construction industry.

BIMarabia 5/22/17

BIM Standard for Autodesk Revit

If you have any questions or comments on this standard, please visit: http://www.bimarabia.com/

If you want to adopt this standard in your organization, please do not hesitate to contact us:

BIMARABIA@gmail.com

المحتويات

1 Introduction

1.1 Background

Introduction

Considering the strategic shift from the ‘Computer Aided Design’ (CAD) platform to the ‘Building Information Modeling’ (BIM) platform, this document represents a documentation of the initial version of the ‘BIMarabia Standards’

This initial version of the standards shall be referred to as ‘Beta Version’ and shall be further upgraded to higher versions in the future.

It was agreed that the ‘BIMarabia Standards’ using the ‘Revit’ platform shall be divided into 3 main categories:

1. Project Template
2. Library
3. BIM Workflow

1.2 The Committee

The group has representatives from architectural, engineering and construction companies in the Arab country, large and small, The BIM committee is working together to realise a unified, usable, coordinated approach to Building Information Modelling in a design environment.

Committee Members

~~~ Omar Selim   BIMarabia ~~~

ACKNOWLEDGEMENTS

Mariem Elmasry   BIMarabia

1.3 Disclaimer

All the advice outlined in this document is for information only. The authors and contributing companies take no responsibility for the utilisation of these procedures and guidelines. Their suitability should be considered carefully before embarking upon any integration into your current working practices.
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1.4 Scope

This Guide is intended to support organizations involved in the process of creation and use BIM models for building projects, and focuses primarily on adaptation the best practices for efficient application of Revit®, However, this Guide does not restrict the use of any other software tools.

The provisions of this Guide are indicative only and may be freely used as a template for development corporate guides.

The guide does not regulate the specifics of the development, workflows and requirements related to the composition and structure of the information model for specific design disciplines. It provides guidance and approaches for the development of documents on information modeling standardization.

The objectives of this Guide are:

- To accumulate the best world practices in the area of BIM standardization and adapt this knowledge to maximum extent for practical use in the Russian Federation.
- To maximize production efficiency through adopting a coordinated and consistent approach to working in BIM.
- To define the standards, settings and best practices that ensure delivery of high quality data and uniform drawing output across an entire project.
- To ensure that digital BIM files and folders are structured correctly to enable efficient data sharing whilst working in a collaborative environment.
- The guide features the information modeling technologies application to the following BIM uses:
- Development, coordination, approval and release of design documentation on the basis of BIM models.
- Interdisciplinary coordination of spatial solutions and identification of conflicts by composing the aggregated models.
- Rational and visual inspection of the BIM-based design decisions.

It is expected that this Guide will be used by experts with the requisite experience and qualifications.

All the advice outlined in this document is for information only. The authors and contributing companies take no responsibility for the utilization of these procedures and guidelines. Their suitability should be considered carefully before embarking upon any integration into your current working practices.

1.5 Update Procedure

Proposed changes and additions to this standard should be submitted in writing with accompanying examples, discussion, or other supportive material to committee. Feedback will be gathered and continuously reviewed; they will be collated to form new revisions at appropriate intervals.

It is expected that this standard will undergo a relatively rapid evolution process, as the industry adapts to the implications and advantages of BIM methodology.

1.6 References

- This standard is written with reference to the following documents
- BS1192:2007
- AEC (uk) BIM Standards 2009
- AEC (uk) CAD Standard 2000
- AEC (uk) CAD Standard Basic Layer Code 2001
- AEC (uk) CAD Standard Advanced Layer Code 2002
- UK BIM Standard for Autodesk Revit
- CORPORATE BIM STANDARD For Building/Construction Projects
- AEC (CAN) BIM Protocol for Revit, Version 2 September 2014;
- AEC (UK) BIM Protocol Project BIM Execution Plan, Version 2.0 September 2012;
- The BIM Project Execution Planning Guide and Templates - Version 2.0, Pennstate;
- AEC (UK) BIM Protocol for Autodesk Revit Model Validation Checklist, Version 2.0 September 2012;
- Employer's Information requirements. Core Content and Guidance Notes, Version 07 28.02.13, BIM Task Group;
- AIA Contract Document G202-2013 Building Information Modeling Protocol Form;
- Level of Development Specification 2015, BIMForum;
- Building Component Catalogue with Level of Development Specification (LOD), Version 2.0 / June 2015, MT Højgaard;
- Dutch Revit Standard, Ver.2.1, 30-01-2015;
- Australian and New Zealand Revit Standards (ANZRS Standards);
- Singapore BIM Guide, Version 2;
- THE PORT AUTHORITY OF NY&NJ, Engineering Department, E/A Design Division BIM Standard, JUNE 2014;
- MT Højgaard CAD-BIM Manual, Date: 08 Oktober 2013;
- Revit Model Content Style Guide (RMCSG) version 2.1;
- GOST R 1.4-2004 "Standardization in the Russian Federation. Standards of

organizations. General."

- GOST R 21.1101-2013 "System of design documents for construction. Main requirements for design and working documents."

1.7 Definitions

The following terms define the concepts of BIM and data structures used in this Standard:

- **2D:** Displaying object geometry and location on a plane (X / Y coordinates).
- **3D:** Displaying object geometry and location in the three-dimensional space (X / Y / Z coordinates).
- **Author:** A designer who creates files, model elements, drawings and other model documentation.
- **Attribute:** Data block that partially describe properties of an item or a library element.
- **Building Information Model (BIM Model):** Digital representation of physical and functional characteristics of the construction object serving as a common knowledge base during its lifecycle (design, construction, operation and modernization).
- A BIM model in a native format is a 3D representation of the construction object, where every element is linked to the model database and element's 2D image in views/drawings. If an element (or its associated information) is modified in a model, the modification is reflected in the database and in views/drawings.
- **Building Information Modeling:** Collaborative process of creation and management of the construction object data, forming the basis for decision making throughout the entire life cycle.
- **BIM Project:** Design of the construction object created using Building Information Modeling (BIM) technology.
- **BIM Uses:** Methods of using BIM in various stages of the construction object's life cycle in order to achieve one or more project objectives.
- **BIM Execution Plan (BEP):** A technical document created by a design company for internal use, as well as for passing to subcontractors. Describes technology aspects of the BIM project development. Specifies the goals and objectives of information modeling, the rules of file naming, the strategy of model spatial division, the required levels of detail in the various design stages, the roles of the process stakeholders and other aspects.

- **Level of Detail (LOD):** The level of development of a building information model (BIM) element. LOD sets the minimum amount of geometric, spatial, quantitative, as well as any attribute information necessary for modeling at a particular stage of the construction object life cycle. Thus, LOD consists of two components: a geometric LOD (G) and an attributive LOD (I).

- **Element:** Part of the building information model representing the component, system or assembly within the construction object and/or the construction site.

- **Component (Autodesk Revit Loadable Family):** An individual element that can be reused, such as a door, furniture, facade panel, etc.

- **Graphical Data:** Data represented by means of geometry shapes properly arranged in space.

- **Attribute Data:** object information that can be represented in the alphanumeric form.

- **Common Data Environment (CDE):** The single source of information for the project, used to collect, manage and disseminate documentation, the graphical model and non-graphical data for the whole design team (i.e. all design information whether created in a BIM environment or in a conventional data format). Creating this single source of information facilitates collaboration between design team members and helps avoid duplication and mistakes.

- **Work In Progress Area:** CDE information which is currently in production and has not yet been checked and verified for use outside of the authoring team.

- **Shared Area:** CDE information that has been checked and approved and is made available across the design team such as information for data exchange between disciplines. Used for co-ordination and collision detection.

- **Published Area:** CDE information that refers to documents and other data generated from Shared information.

- **Archive Area:** All output data from the BIM, including published, superseded and „As Built" drawings and data.

- **Aggregated Model:** Assembly of distinct models to create a single, complete model of the construction object.

- **Collision Detection:** Process of finding design errors resulting geometric intersections such as the intersection of two or more objects, violations of tolerances or logical dependencies between elements, etc.

- **Employer Information Requirements (EIR):** BIM project owner requirements defining the information to be provided to the owner throughout the design development, as well as the

requirements for information standards and regulations that the project participants shall adhere to.

- **Information Exchange:** Collection and presentation of information that meets the requirements for its format and degree of confidence in a pre-set stage of the project.
- **RVT:** Basic Autodesk Revit model file format.
- **RTE:** Autodesk Revit template file.
- **RFA:** Autodesk Revit loadable family file.
- **RFT:** Autodesk Revit family template file, used for creating new families. Each Revit category has its own family template.
- **NWC:** Autodesk Navisworks file format enabling data exchange with RVT, DWG, IFC etc.
- **NWD:** Autodesk Navisworks Document file format. Intended for batch saving all model data into a single file and transfer to third parties. Transfer settings are configurable.
- **NWF:** The basic Autodesk Navisworks working file format. Contains links to the loaded design files by discipline, as well as all viewpoints, animations, construction simulations, collision checks and information model environment.
- **DWG:** The native file format for AutoCAD data files. It contains all the pieces of information a user enters, such as designs, geometric data, maps, etc.
- **PDF:** Cross-platform electronic document format developed by Adobe Systems. There are many PDF viewers, including the official Adobe Reader.
- **DWF:** An open file format developed by Autodesk for sharing, viewing, printing and reviewing design data. Opens in the free Autodesk Design Review software, as well as in Web browsers and on mobile devices using the Autodesk 360 cloud-based services. The DWF information may also be used in Revit and AutoCAD.
- **FBX**: Technology and file format that is used to ensure compatibility of various 3D graphics software. Autodesk Revit information model is exported in this format to the visualization applications, such as Autodesk 3ds Max.
- **ADSK:** Files for the exchange of information between Autodesk Revit / AutoCAD Civil 3D and Autodesk Inventor / Autodesk Revit.
- **BCF:** File format for exchange of notes/comments related to the design. Attaching the screenshots is supported.
- **DWT:** Template file in AutoCAD and AutoCAD Civil 3D.

- **IFC:** Industry-standard open and versatile format for BIM data exchange.
- **gbXML (Green Building XML)**: An open XML-based format for storing and exchanging geometric information on building envelopes. It is used to transfer data from BIM models to thermal performance calculation software.

Project BIM Co-ordinator	Responsible for setting and implementing Project BIM Strategy, this person would usually be the most experienced Revit user.
BIM	Building Information Modelling (BIM): Data beyond graphics. The creation and use of coordinated, internally consistent, computable information about a building project in design and construction.
Component/ Family	A component (known as a family in Revit) is an individual element that can be reused in a number of situations. Examples include doors, stair cores, furniture, façade panels, columns, walls etc. Components are typically inserted and moved/rotated into required position.
Assembly	A collection of components and/or modelled elements arranged to define part or all of a building model such as groups or sub- models in Revit. An assembly typically contains information that can be referenced without repositioning.
Container	An optional repository which can be used to compile assemblies and components for specific purposes including export and publication. A container can exist for each individual profession/discipline or for multiple disciplines, for buildings or for a complete project.
WIP	Work In Progress (WIP): each individual company or discipline"s own work. This information has not been approved or verified fit to share across the project team. Reference BS1192:2007.
Shared	Information that has been checked and approved and is made available across the project team such as information for data exchange between BIM software, like gbXML, CIS/2 and IFC files. Reference BS1192:2007.
Published	Published information refers to documents and other data generated from Shared information. Typical`ly this will include contract drawings, reports and specifications. Reference BS1192:2007.
Views/ Output files	A generated rendition of graphical or non-graphical information (a plan, section, elevation, schedule, or other view of a project).

Basic Autodesk Revit Terms and Definitions

- **Category:** A group of elements used for the construction object modeling: windows, doors, walls, floors etc. Categories are classified depending on their purpose:
    - model categories;
    - view categories;
    - annotation categories.

  Each category has its own set of properties and parameters, as well as the behavior and interaction rules. Categories cannot be created or edited by users.
- **Families:** Groups of elements with a common set of parameters, identical use, and similar graphical representation.
- **System Families:** Are created and edited in dialog mode; follow the severe system restrictions. Can be only stored within project files, templates and families.
- **Loadable Families:** Are created and edited in the built-in editor by means of combining the geometry elements, constraints and parameters. Can be stored within project files, templates and families, as well as in separate RFA files.
- **In-place Families:** Are created and edited in-place within the design file, in the family editor by means of combining the geometry elements, constraints and parameters. Establishing the geometric constraints with other design elements is possible.
- **Nested Families:** Loadable families used inside other families; can be constrained. Ignored in quantities/schedules.
- **Shared Families:** Nested families that can be counted towards the quantities/schedules.
- **Types:** Family elements differing by the property/parameter values.
- **Elements:** Data instances that get individual location/relation properties and parameters within the design.
- **Type Catalog:** A logical sequence of loadable family data in TXT format with the appropriate file naming. Using catalogs allows to only load the needed types in a large loadable family.
- **Templates:** Preconfigured files that are used to create new designs and families.
- **Family Templates:** Templates containing the required baseline data and settings to create certain categories of new loadable families.

- **Design Templates:** Templates containing the required baseline data and settings to create new designs for certain disciplines. Also define which kinds of design documentation shall be released.

- **Worksets:** Collections of model elements, families, views and settings. Supports appointment of the owner and the borrower for the processes of team work:

    - **Owner:** User who has the right to edit model elements and worksets.
    - **Borrower:** User who only has the temporary right to edit workset elements.

- **Repository File (Central File):** Design file that contains the worksets and is stored in a network folder that is accessible to all project participants.

- **Local File:** A copy of the repository file created by opening it and immediate resaving to a local folder. Another way to get the local file is opening the repository file with *Create New Local* option enabled. The folder for storing a local file is set in *Options* dialog under *Default path for user files*. Changes in local files are synchronized with the central file.

- **Family Editor:** A special Autodesk Revit work environment; contains only tools needed for family creation.

- **Parameter:** Property of a Revit element which can be formed and set either while creating a family in the Family Editor or in the design file itself. Parameters allow you to change the element without editing it in the Family Editor.

- **Project Parameter:** A parameter that is created in the design file and can be assigned to any element category. It can be counted towards the schedules. Inclusion of project parameters into tags is not supported.

- **Shared Parameter:** A parameter that can be included into schedules and tags; it can be shared across various projects. You need to specify the file for storing a common parameter during its creation. If the file does not exist, it shall be created in the process of the design development.

- **Shared Parameter File:** A structured file of TXT format; contains the shared parameter definitions.

- **View:** Display of the model data in various perspectives, sections and representations. There are graphic views (plans, sections etc.) and text views (schedules etc.)

- **Project Browser:** Autodesk Revit control that displays the hierarchy of all views, schedules, sheets, families and groups.

- **Unique Reference System:** The file containing the definition of absolute and relative coordinates of the project, as well as the direction of true north. There is only one Unique reference system file in each project. Its main role is the spatial coordination of all BIM model disciplines.

- **Space Decomposition File:** The file containing grid axes and levels. It shall be loaded as a link into all discipline design files. Axes and levels in these files are created then by means of Copy/Monitor tool. That makes possible to centrally control the position of the grid axes and levels throughout the whole design.

- **Shared Coordinates:** absolute and relative coordinates of the project that are shared by all design disciplines through the Unique reference system.

- **Grid Axes:** Elements of horizontal space decomposition in the BIM model.

- **Levels:** Elements of vertical space decomposition in the BIM model (by floor and by key elevation).

General Guidelines for Project Templates

central 'Project Template' file would be created for the following disciplines:

- Architectural
- Structural
- Mechanical
- Electrical
- Communications
- Plumbing and Fire Fighting

Revit 'Project Templates' are considered to be the starting point of the project. 'Project Templates' should include the standard elements needed for a Project taking into consideration the following 2 points:

- Elements included should be the most commonly used not occasionally used.
- Should avoid elements that can cause unnecessary increase in the 'Project Templates' size.

Item	Format	Example
Project Templates	Template BIMARABIA_Version	"Template BIMARABIA_01.rte"
Discipline Templates	Discipline-Template BIMARABIA_Version	"A-Template BIMARABIA_01.rte"
Views	Description	"First floor Duct Work Plan"
Sheets	Project # Building #-Discipline Serial Part	"1121B01-A101a"
View Groups	Discipline - View Group Description	"E-Power Plans"
View Templates	Discipline-Serial Description-Scale	"E-100 Lighting-1_100"
Filters	Discipline-Description	"E-Hot water supply"
Materials*	Material Name	"Acoustic Tiles"

Worksets	Discipline-Description	E-Lighting

*only for the additional

The major elements considered to be included in the 'Project Templates' are:

1. **Views and Presentations:**

This section controls the Project Views, Visibility and Presentation. Items that need to be defined in that section are:

- Views and Sheets Browser Organization: This defines the hierarchy and sorting of the 'Views' and 'Sheets'. It was agreed that for all 'Project Templates' the Sheet Series (100, 200...) would be used for sorting the 'Views' and 'Sheets'.
- Graphics: This defines the Presentations of the different Elements and different Views. This includes:
- View Templates
- Filters
- Object Styles
- Line Styles, Line Weights, Line Patterns and Fill Patterns
- Detail Level (Coarse, Medium, Fine)

2. **Schedules:**

Commonly used Schedules should be loaded into the 'Project Template'. These can be divided into 3 categories:

- BOQ/Documentation Schedules: Schedules that are needed and are part of the 'Construction Documentation'.

- Review Schedules: Schedules that are not part of the 'Construction Documentation' package but are used for checking or for data inputting.

- Pricing/QS Schedules: Schedules that are used for pricing or Quantity Surveying purposes.

3. **Annotations:**

This Section contains the main project 'Annotation' and 'Tagging' features that are needed to be present in the 'Project Template'. These are mainly 2 categories:

- System Families:

These need to be defined from within the 'Template'. These include:

- Grids, Levels
- Section, Elevation, Callout Tags
- Dimensions Styles
- Viewport: Title

These are generals and should be defined and consistent throughout all 'Project Templates'.

- Loadable Families:

These are the 'Library Families' that would be loaded into the 'Project Template'. These include:

- General Annotations
  (These are General Annotations that are used in defining the System Families e.g. Grid Head, Section Head...etc or Generic Annotations used as Symbols)

- Annotation Tags
  (These are discipline specific and vary for each discipline's 'Project Template')

- Title Blocks
  (These are project specific and would be adjusted for each project)

Note: For all Annotations, consistent Text Heights, Fonts, Colours...etc should be maintained.

4. Materials:

Basic Material types of Finishes, Concrete...etc should be defined in the 'Template'. The definition includes:

- Material Name and Class: Defining the standard 'Material Name' using the Standard 'Naming Conventions' (see Appendix: A) and 'Material Class' in the 'Identity: Filter Criteria'.

- Graphical Representation: Defines the 'Surface Pattern', 'Cut Pattern' and 'Shading' of the Material.

- Render Appearance: Defines the Material Appearance in Rendering.

5. Model Element Families:

The Basic 'Model Element Families' that are commonly used in all projects should be part of the 'Project Template'. These are divided into 2 main categories:

- System Families:

The Basic 'Family Types' of these 'System Families' would be defined from within the 'Project Template'.

- Loadable Families:

These are the Basic Families from the 'Library'. These would be loaded into the 'Project Template'.

Other project specific families would be stored in the library and loaded into the project whenever needed, to avoid unnecessary increase in the 'Project Template' size.

6. Shared Parameters:

Any 'Parameter' defined in the 'Project Template' should be saved in a 'Shared Parameter' text file within the same folder and given the same name as the 'Project Template'.

The 'Shared Parameters' of the 'Loadable Families' should be added into the 'Project Template' while loading the Family.

7. Worksets:

General 'Worksets' Structure shall be defined in the 'Project Template'. Additional 'Worksets' required in Projects shall follow the same guidelines.

The 'Project Template' shall be saved as a Revit Project '.rvt' in order to maintain the developed 'Worksets'.

Effective Ways of Template Creation

Though this list is not exhaustive, many of recommendations given here will improve productivity and efficiency.

- Create a new empty drawing view, which will be used to open the design, and specify it as the Starting View. It is displayed when you open the design file, regardless of which view was active before the last save. This will prevent loading graphically rich views, free up more RAM and increase the project loading speed. The Starting View may, for example, contain a description of the company standard main parameters.
- Do not include too many families in one template. To reduce the project size, load only those families that are used often (for example, the most basic windows and doors).

- Set the parameters in advance and add the key notes (if your company uses them) for any families that are loaded in the project.
- Don't load too many wall types; 5 or 6 most frequently used is quite enough.
- Set all the parameters for wall types included in your design (for example, type label, class of fire danger, etc.)
- Set up a few default sheets for permanent use: for example, the title page for a specific set of drawings. Typically, this list looks the same in all projects, so it shall be prepared in advance with room left for images, schedules, etc. The same recommendations apply to the sheet that contains details.
- Create view templates that will define the design standards when creating new views.
- Upload a few standard title blocks. Attach one or two title blocks for presentations and load the standard title block for design documentation. Attach title blocks for additions.
- Set up standard schedules. Create a room schedule, window opening fill quantity and equipment schedule. This will allow having schedules at hand during the design development.
- Create a few drawing views for standard parts (e.g. parts of doors and windows) which are regularly used in all designs.
- If renovation projects constitute a considerable portion of the company's business then set up the stages and graphics overrides.
- Use the *Transfer Project Standards* feature to import elements from other templates.
- Migrate templates to the newest Revit release before the new project starts.

Autodesk Revit Architectural Template Checklist

A list of items to be included in the design template follows below.

- **Sheets**: Create and set up sheet skeletons for project release.
- **Line styles**: Set up standard styles and purge unneeded ones.
- **Line weights**: Set up standard weights and purge unneeded ones.
- **Line patterns**: Set up standard patterns and purge unneeded ones.
- **Text styles**: Set up standard styles and purge unneeded ones.
- **Dimension styles**: Set up standard styles and purge unneeded ones.
- **Title blocks**: Load standard title blocks.
- **Wall types**: Set up standard types and attach a few shared types to be used to create quick sketches. Only the most frequently used types will be required.
- **Roof types**: Set up standard types.

- **Slab and floor types**: Set up standard types.
- **Ceiling types**: Set up standard types.
- **Project Browser arrangement**: Customize the arrangement and display of views and sheets in Project Browser. The arrangement is often based on the user parameters.
- **Parameters**: Define and add all necessary parameters.
- **Door families**: Create the most frequently used templates and add them to the template.
- **Window families**: Create the most frequently used templates and add them to the template.
- **Keynotes**: Create a classifier and select the keynote file (if the company uses the classification system).
- **Quantities and schedules**: Create the most frequently used schedules, such as door schedules and window schedules.
- **Legends**: Create the standard legends, such as door/window legends, flooring schedule etc.
- **DWG export**: Define the export settings in accordance with the corporate CAD standard.
- **DWG import**: Define the import settings if needed.
- **Title sheet**: Set up the title sheet.
- **Shared data sheet**: Set up the shared data sheet.
- **Project units**: Set up the project units.
- **File locations**: Define project file locations for quick navigation and saving.
- **Site parameters**: Define and set up the contour display, sections and parcel boundaries.
- **View templates**: Create standard view settings and save them as the view templates.
- **Hatch/fill patterns**: Create and load needed hatch/fill patterns.
- **Materials**: Create and set up the most needed materials.
- **Object styles**: Add new object styles and review the existing ones.
- **Phases**: Create if needed. Inclusion into a separate template may be required.
- **Levels**: Create the needed levels on the elevation views.
- **Color fills**: Create the basic color fills if needed

- **Display filters**: preset the display filters in accordance with the planned design requirements.
- **Ticks**: Set up if needed.
- **Tags**: Configure to match the standards and load the most needed ones into the template.
- **Temporary dimensions**: Set the temporary dimensions' properties.
- **Snaps**: Set up the snap parameters.
- **Hotkeys**: Set up the most frequently used hotkeys. Their desired combination can be exported to an XML file.
- **View level of detail**: Set up the LOD for the newly created views.
- **Annotation symbols**: Customize annotation symbols to match the standards; load the most commonly used ones, such as North arrow, grid axes, elevations marks, etc. into the template.
- **Additional components**: Add other frequently used families (furniture, columns, entourage etc.) to the template.

2 Best Practice

To achieve technical excellence and a successful outcome to a project, it is essential that BIM working and subsequent drawing production output is carefully planned. This must involve explicit attention to management, display and quality of the design data. Below are a number of best practice key principles that will aid efficient, high quality working.

2.1 BIM

- A Project BIM Co-ordinator shall be appointed for every project.
- A Project BIM Strategy shall be put in place that identifies key project tasks, outputs and model configuration.
- BIM Project Reviews should be agreed and take place regularly to ensure model integrity and project workflow is maintained.
- Develop clear guidelines for internal and external collaborative working which maintain the integrity of electronic data.
- Identify clear ownership of model elements through the life of the project.
- Understand and clearly document what is to be modelled and to what level of detail. Do not over model.
- Sub-divide models between disciplines, and within single disciplines to avoid file sizes becoming over ~100MB. Refer to Section 5.
- All changes to the model shall be carried out as 3D modifications, rather than
- 2D „patches" to maintain the integrity of the model.
- Outstanding warnings shall be reviewed regularly and important issues resolved.
- The Central file shall never be opened, only copied to create local files.
- The Central file should be recreated at regular intervals in order to eliminate redundant data retention.

2.2 Drawing Production

- A drawing shall contain design information solely for the purpose of the intended use of the drawing.
- To maximise efficiency a policy of minimum detailing without compromising quality and integrity shall be adopted.
- Numbers of drawings should be kept to an absolute minimum and organised in a logical manner.
- Avoidance of view duplication is essential to ensure drawings maintain their integrity as the iterative design process progresses and amendments are made.
- Efficient minimum detailing and above all the elimination of detail repetition shall be the method adopted.

❖ Using Families in the Design

Loadable, system and in-place families are used in designs.

All families developed in-house or provided by building products, equipment and construction materials manufacturers, as well as acquired from third parties and passed through the quality checks become an integral part of the company's central BIM resource library.

Library families can be developed both within the organization and by external parties, including equipment manufacturers.

The portion of the central library components that is used in a particular design is part of the design BIM resource library. If there is a need to create new families in the course of design development, they are developed according to certain rules, as described in the relevant regulations. These families are saved in the library of a specific design.

Names of all families and types shall accord with the naming rules.

❖ Development of families

All families shall be developed on the basis of the pre-defined methodology (see 5.4).

To use the agreed names and avoid redundant data when creating parametric families, shared parameters are recommended. The corporate shared parameters file shall be applied for this purpose. This is particularly important when using different LOD for the same element, since there will be several different versions of the file.

The following recommendations shall be observed during the family creation:

- Accurate definition of the family's purpose, expected behavior and necessary parameters is needed.
- Parameters can help to determine which element data should be included into scheduled. You need to plan this in advance.

- Needed LODs shall be planned for the family in advance.
- Autodesk Revit supports three levels of model elements graphical representation; this shall be taken into account during the family planning.
- When determining the level of detail for the family geometry, keep in mind that there is no need to model the geometry that will not be visible in the design. You do not need to duplicate geometry which can be used for different levels of detail.
- More detailed family means the larger file size. The larger the file, the slower family loading and regeneration.
- Careful attention shall be paid to the selection of the appropriate family template file, as it will determine the further behavior of the component.
- Component visibility in different views can be adjusted. For example, for a floor plan you can specify that the 2D projection of the element should be displayed, while 3D views will show it as the three-dimensional body.
- When you create parameters, use the *Edit Tooltip* tool to add a description. Ability to add parameter tooltips was first introduced in Autodesk Revit 2015.
- Complex families need documentation describing the functionality and the key parameters that determine the behavior of the family.
- Use type catalogs when you create families that contain a lot of different types.
- Avoid importing CAD geometry into the family file.
- Use subcategories for more precise control of the family elements' visibility.

❖ Nested families

Families can contain other (nested) families.

The following recommendations shall be observed when nested families are used:

- Depth of nesting shall not exceed two levels. The deeper the nesting, the slower is the family update.
- Use families that are nested into several other families carefully: loading of a changed nested family into the design causes the change of all families that contain it.
- For each particular family, the number of families nested into it shall not exceed 6.
- If the nested families' parameters need to be included into schedules/quantities, assign the "Shared" parameter to the family in Editor.

❖ Family file size

Family file size shall be minimal, but for each individual case it is necessary to assess the approach rationality: sometimes it is more efficient to use one complex family that allows addressing a lot of issues, than bring in a lot of more simple families.

To make the file size smaller, the following recommendations shall be observed:

- Unused elements shall be purged and the family file itself shall be audited before using it in the design.
- Nesting of families shall be kept minimal.
- Non-standard materials and textures shall be avoided where possible.
- Only elements that are covered by the required LOD shall be modeled.
- All CAD underlays and raster images shall be deleted from the family file.
- CAD files shall never be xploded in the family.

❖ Creating types in loadable and system families

Sometimes during the design development it turns out that the author finds no suitable type of a particular model component. In such a case, creation of a new type based on an existing one is allowed.

Creating a new type based on an existing one shall be done by means of making a copy and assigning a new name. Editing of existing types is not recommended.

❖ Family validation

Families that are being created shall be validated:

- in the Family Editor environment,
- in the design environment.

  During the family validation in the design environment, it is recommended:

- to validate behavior of all family parameters,
- if a large number of families are being created, allocate a tester person (different from the family author) who will perform a “spot validation” on up to 10% of components.

❖ Validation in the Family Editor environment

- Check all family parameters to ensure the correct geometry change when the parameters are adjusted.
- Check all types in family: change the type, apply it, and then review the geometry to make sure that all sizes and proportions are retained.

- For hosted families: check that they are properly adjusted to the changes in the host size. Change the host thickness and make sure that the family correctly changes its geometry.

- Check all views for correct display of family graphics at different levels of detail and different visual styles.

- Check constraints/dependencies:

    - check grips on the geometry edges to make sure that all geometry is snapped either to reference planes or to the witness lines,
    - check the dimension parameter to make sure it is snapped to the reference plane / witness line and not to the geometry itself.

- Check connectors:

    - right choice of the connector type,
    - linking connectors,
    - flow direction.

❖ **Validation in the design environment**

- Load the family into a design and check all views for the correct display. If the family has a catalog, use it to load the required types.

- Visually inspect the family in all views, at all levels of detail (coarse / medium / fine) and all visual styles.

- Check all types in family: change the type, apply it, and then review the geometry to make sure that all sizes and proportions are retained.

- Create new types, change all parameters and check the display in all views.

- Change all materials and check correctness of their assignment to geometry. To better check the material assignment, change all material parameters to the “glass”. If any part of the geometry does not appear as “glass”, it becomes clear that the parameter is wrongly assigned.

- For hosted families:

    - place the family onto a host that has the specified thickness and make sure that the family behaves correctly on all applicable hosts,
    - adjust host thickness (25-400%) and check whether family geometry become detached,

- re-check the family appearance to make sure the geometry display is correct,
- perform a test visualization,
- check the work of *Copy/Paste*, *Rotate* and *Mirror* commands.

Item	Format	Example
Annotation Families	Discipline-Element-Description-BIMARABIA_Version	“E-Lighting Switches-Control Tag-BIMARABIA_01.rfa”
Model Element Families	Discipline-FamilyName-SubCategory-BIMARABIA_Version	“A-Door-Single Flush-BIMARABIA_01.rfa”
Model Element Family Types	[To be discussed as per family types]	
Details Families	Discipline[D]-Category Name-SubCategory-BIMARABIA_Version	“AD-Roof-Finishing-BIMARABIA_01.rfa”
Titleblock Families	Description-BIMARABIA_Version-Project	“A0 Portrait-BIMARABIA_01-1033.rfa”

Ensuring Model Quality

❖ Model maintenance

Autodesk Revit models must go through the maintenance on a regular basis in order to improve stability, speed and efficiency. Irregular maintenance can cause distortions in the models and thus directly affect the work performance of all design disciplines.

The maintenance process includes checking Autodesk Revit model, model file compression, verification and elimination of errors, eliminating unused items, removing unnecessary views etc.

❖ Repository file

It is prohibited to open the repository file storage during the everyday design process. Its opening is only allowed for the purpose of model maintenance.

The repository file shall be re-created and re-saved as a new file at regular intervals to prevent the appearance and accumulation of redundant data. This action shall be carried out regularly. Saving frequency is set out empirically, depending on the model size.

Local files are created daily to improve efficiency. Avoid continuing design work at the beginning of the working day by opening of the saved local file (*Update Time Stamp*) and reloading the latest changes (*Reload Latest*). Such practice is only allowed if the models are temporarily disconnected from the network.

❖ Compression of repository file and local files

Repository file compression reduces the storage size when saving files that use the worksets. Normally Autodesk Revit applications only add the new and changed items to the existing files during the save operation. This increases file sizes, but speeds up the save process. The compression process overwrites the entire file and removes obsolete data to save space.

Since the compression process takes longer than the usual saving, compression shall only be done if the interruption of the working process is permitted. Compression shall be launched by the BIM Manager/Coordinator.

❖ Importing and linking files

To speed up handling of models that contain linked files you shall unload all links that are not necessary for a particular task. As required, files can be reloaded.

❖ Warning messages

All warnings, in particular related to geometric errors, collisions and incorrect settings of engineering systems, shall be checked on a regular basis, and their causes shall be eliminated. Users shall remove the cause of the warning message, and the BIM Manager/Coordinator shall view a list of messages as frequently as possible.

Current number of warning messages shall not exceed 200. A larger number of warnings influences the model appearance and can cause other problems with the model.

Ordinary warnings are not as important as the geometric errors and engineering systems

warnings. They may be ignored; however they also affect the efficiency.

- **Archiving the model**

The model shall be archived before publishing. For the aggregation of models and all the related files eTransmit function should be used.

Models shall be archived at their integrity on each date and at each stage of the documentation publication. Archiving shall also include related files and the set of published documents in DWF/PDF format. Archived files are stored in a folder with the appropriate label.

- **Saving the model**

The maximum number of backup copies of Autodesk Revit model shall be at least five times greater than the total number of users working with it. If the team is less experienced, it is permissible to increase this figure to ten. Available storage space shall be requested from IT professionals responsible for the project. Also note that overwriting the repository file causes the loss of all previous network backups. Don't forget to archive the project before overwriting the central model!

Backup copy of the repository file shall be saved daily; it has to be done by copying the whole repository folder.

Synchronize with Central command shall be executed at least hourly. It is necessary to avoid model hang-up: synchronized saving shall be coordinated and carried out at regular intervals, especially if large group of specialists share one model. Worksharing Monitor can be used to review the modeling activity level.

Revit save reminder interval shall be set to 30mins.

An initial view that contains mostly text shall be specified in the design files in order to speed up the file opening process.

3 Project BIM Strategy

3.1 SETTING UP AND ORGANIZING THE BIM PROCESS

3.1.1 Employer Information Requirements (EIR)

EIR is a document included into the design specifications in order to shape the requirements to information provided to the client during the BIM project development and on its completion.

Employer information requirements form the basis of the BIM Execution Plan (BEP).

Details of information requirements depend on the client's BIM competence level.

The document shall contain the following sections:

- Goals and objectives of using BIM on the project.
- Work stages and information delivery milestones.
- Minimum requirements for the number of modeled design disciplines and depth of modeling (for each discipline).
- Requirements for the level of detail (LOD) for each stage and discipline.
- Requirements for the model elements classification system (if applicable).
- Requirements for the content and format of design output.
- Requirements for the BIM models testing regulations.
- Requirements for the approval and change procedures, file exchange format and shared network resources.
- Other sections, as applicable.

3.1.2 BIM Execution Plan (BEP)

The main objective of the BIM Execution Plan (BEP) is the planning and organization of effective collaboration of all design team members at all stages of BIM project.

The BEP is a dynamic and a periodically changing document.

The BEP should be developed in collaboration with all information modeling process participants (both internal and external). All participants shall reach a consensus on how to set up, organize and control the information model. Such a consensus should be documented in the BEP.

The BEP shall define and document the following aspects:

- Goals and objectives of the use of BIM in accordance with the employer information requirements (if applicable).
- BIM final results.
- Infrastructure needed for successful project execution.
- BIM process.

See details on the BEP compilation in Appendix B, "BIM Execution Plan (BEP) Template".

3.1.3 Roles and Responsibilities

There are three primary functions in BIM process:

- Strategic
- Management
- Production

The main functions should be distributed among the Roles.

The Fig. 1 shows the roles (BIM Manager, BIM Coordinator, and BIM Author) and correspondent responsibilities. In small projects and small companies, most of responsibilities can be performed by one person or a group of persons.

	Strategic						Management				Production	
Role	Corporate Objectives	Research	Process + Workflow	Standards	Implementation	Training	Execution Plan	Model Audit	Model Co-ordination	Content Creation	Modelling	Drawings Production
BIM Manager	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N
Coordinator	N	N	N	N	N	Y	Y	Y	Y	Y	Y	N
Modeller	N	N	N	N	N	N	N	N	N	Y	Y	Y

Roles and Responsibilities

❖ **Strategic function**

Execution of this function is assigned to the BIM Manager.

Primary responsibilities are:

- Developing the corporate BIM strategy
- Best practice / research
- Creating BIM processes and workflows
- Creating and supporting BIM standards and protocols
- BIM implementation
- Training strategy.

It is important to understand how vital a BIM Manager's role is. It is not simply a rebranded CAD Manager, nor does it replace the CAD Manager's role. It is about understanding what BIM can achieve: vision, engaging external stakeholders, collaborating partners. Somebody credible has to be responsible for the BIM strategy, the process change and the cultural impact. In-house or outsourced, successful models cannot be built without a strategic manager.

❖ **Management function**

Execution of this function is assigned to the BIM Manager and/or BIM Coordinator.

This is a project focused role, primary responsibilities being:

- BIM Execution Plan
- Auditing the project data and modeling principles
- Participation in the interdisciplinary coordination meetings
- Content creation and distribution, content quality control.

Each project needs Coordinator(s) to help set up the project, audit the model and co-ordinate with all collaborators. Multi-disciplinary co-ordination with BIM is essential. Coordinator(s) may manage several small projects.

❖ **Production function**

Execution of the function is assigned to the BIM Authors. They are discipline-specific designers working on different parts of the project with skill and experience in BIM software.

This is a project focused role, primary responsibilities being information creation.

BIM experience is not essential to produce the model but technology skills are. Therefore all the employees at this level should have the appropriate skills.

3.2 Project BIM Strategy Document

A Project BIM Strategy pro-forma and a complementary Project BIM Strategy Guidance Note are available and shall be used to ensure consistency between projects. Larger and more complex projects may warrant additional clarification; the strategy document will expand accordingly.

The Project BIM Strategy document shall address as a minimum the following key items:

Standards: The BIM standard used in the project and any deviation from that standard

Software Platform: Defines BIM software to be utilised and how interoperability issues will be addressed.

Stakeholders: Identifies project leadership and additional stakeholders and their roles and responsibilities.

Project Deliverable: Defines the project deliverable and the format in which it is delivered and exchanged.

Project Characteristics: Number of buildings, size, location etc. Division of the work and schedule.

Shared Coordinates: Defines the common coordinate system for all BIM data. Details modifications to imported DWG/DGN coordinates.

Data Segregation: Addressing such issues as workset and linked file organization to enable multi-discipline, multi user access and project phasing as well as ownership of project BIM data.

Checking/Validation: Defines the checking/validation process of drawings and BIM data.

Data Exchange: Defines the communication protocols along with the frequency and form of data exchange.

Project Review Dates: Sets out key dates for reviews of the Revit model which all teams buy in to (both internal to the company and externally with the full design team).

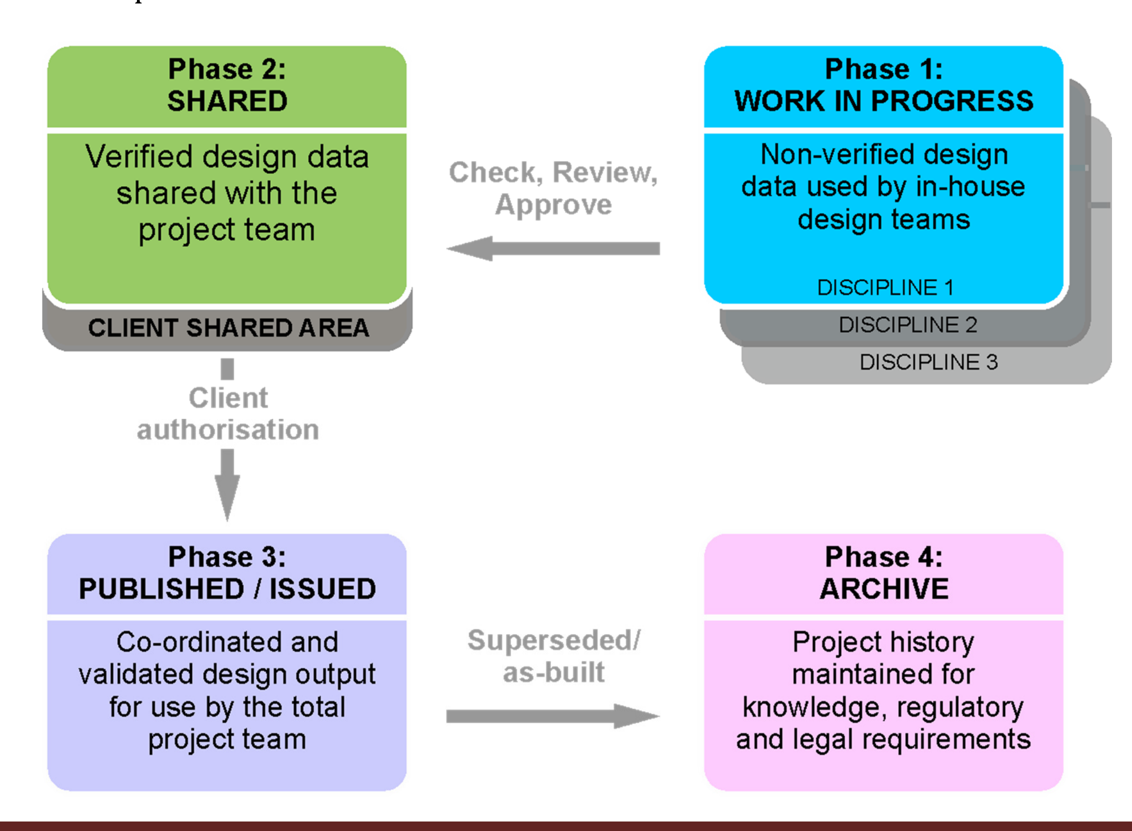
4 Collaborative BIM Data Sharing

This Standard is aligned with **BS1192:2007 Collaborative Working**, which defines the process for project collaboration and efficient data sharing. A major constituent of collaborative environments is the ability to communicate, re-use and share data efficiently without loss or misinterpretation.

4.1 Common Data Environment (CDE)

A **Common Data Environment (CDE)** approach allows information to be shared between all members of the project team.

There are four phases to **CDE** as illustrated below:



4.2 CDE Phase 1: Work In Progress (WIP)

Data described as Work in Progress is that which is currently in production and has not yet been checked and verified for use outside of the authoring team.

WIP model files shall be developed in isolation and contain information for which each stakeholder is responsible.

These shall be stored in, and worked on from the team‟s WIP section of the filing system.

4.3 CDE Phase 2: Shared

To facilitate co-ordinated, efficient working, each party shall make their design data available for project-wide formal access through a shared repository or exchange protocol. These files shall be accessible by all from a central location, or replicated in the **Shared Area** of the project folder structure of each party. Prior to sharing, the data shall be checked, approved and validated as „fit for co-ordination" in line with the BS1197 workflow.

Only BIM files validated „fit for co-ordination" shall be transferred to the Shared

Area *(see section 4.6 for validation process)*.

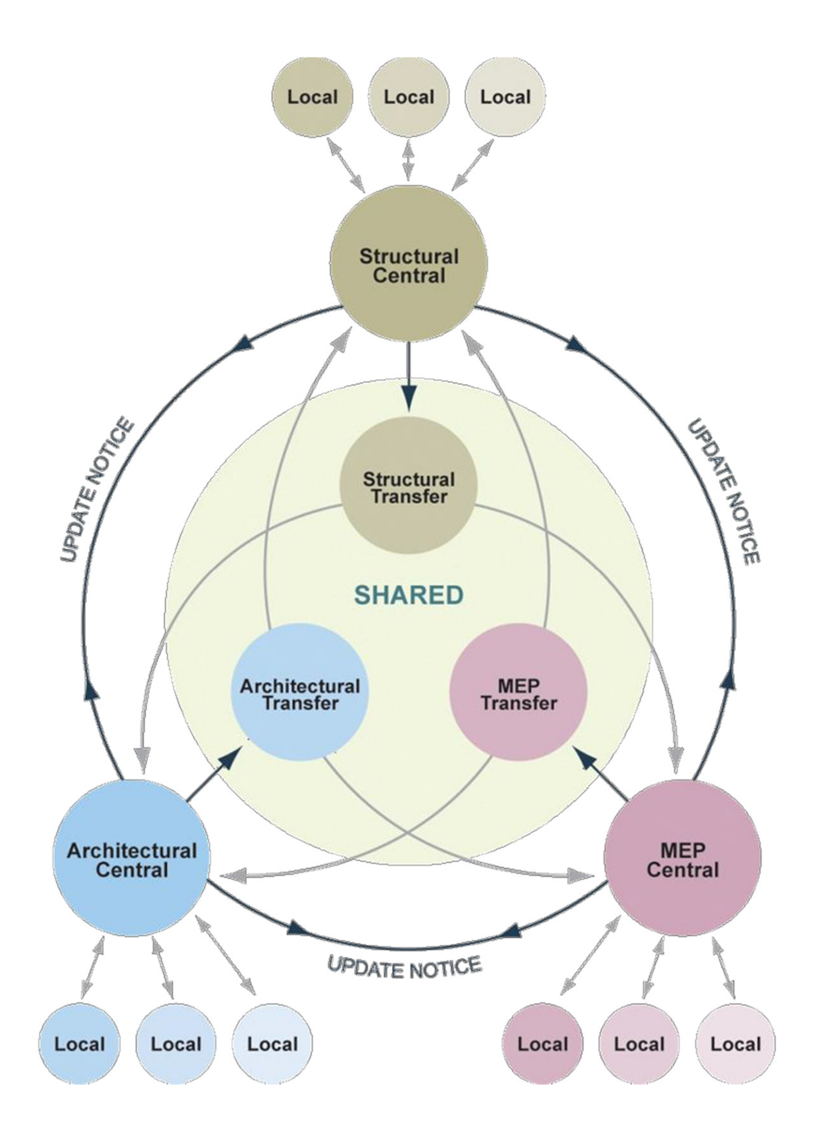
Sharing of models shall be carried out on a regular basis in order that other disciplines are working to latest validated information as defined in the Project BIM Strategy document.

Model files shall be issued in conjunction with verified 2D document submissions to minimise the risk of errors in communication.

The Shared Area shall also act as the repository for formally issued data provided by external organizations that is to be shared across the project.

Changes to the shared data shall be effectively communicated to the team through drawing issue, change register or other suitable notice, such as e-mail, as defined in the Project BIM Strategy document.

For indicative purposes, the Shared area is shown here as a single shaded region. This may, in truth be synchronised locations for each stakeholder.



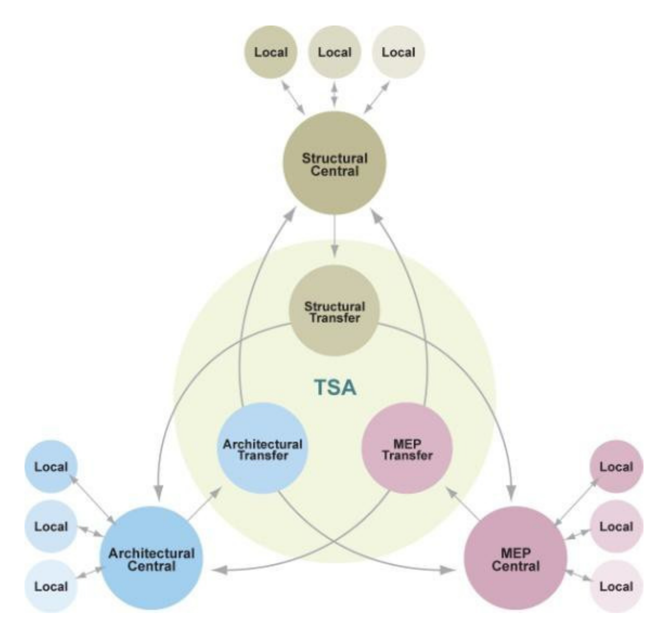
4.3.1 Inter-Discipline Access to WIP

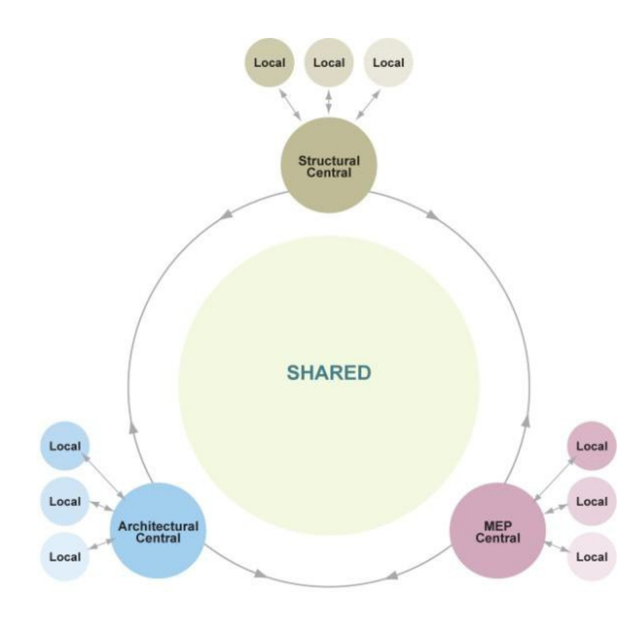
On occasion, project time-frames do not accommodate the delays associated with the checking and verification of information originating from another discipline or company. Such workflows are non-compliant with the BS1192 workflow, and as such, are not recommended. Where necessary however, protocols which provide access to other party‟s WIP models may be applicable through either „Direct Access‟ *(real-time)* or a „Temporary Shared Area‟ (TSA) *(near real-time)*.

Both of these methods carry risk as they involve the use of non-verified data as the basis for design decisions.

The BIM Co-ordinator, in liaison with the design team, shall decide whether to permit access to the WIP models, and if so whether to utilise *real-time* or *near real-time* data sharing.

Access via the **“TSA” “Direct Access”** via the WIP





Medium Risk

Data is transferred at pre-defined intervals into a repository for linking by other teams.

Allows for an amount of un-official communication of model changes avoids use of rapidly changing data

The temporary shared area will reside in **WIP** under **WIP_TSA** repository *(see section 8.2 - Project Folder Structure).*

High Risk

Referenced data is live and subject to fluid design change, without notice or delay.

Used when the time available to a design team is too restrictive to wait for validated information to emerge.

Internal / external use Appropriate only for internal us in multi-disciplined design and engineering practices

This method requires that permissions be granted such that other disciplines can access the WIP.

Warning!

Access to model data held within the WIP will contain un-validated data. It will be subject to rapid change and should be used with caution. Neither of these methods are a replacement for the verified sharing of data defined in section 4.3

4.4 CDE Phase 3: Publication and Document Issue

2D DWF or PDF drawings and sheets shall be stored in the **Published Area** of the folder structure once formally checked, approved and authorised in accordance with corporate quality procedures.

Revision/Issue control shall follow the Document Control systems established for the project.

A record of all issued deliverables shall be maintained in softcopy and hardcopy where appropriate.

Information within a BIM is inter-dependent and changes in one view may affect other views. As such the BIM files and all associated views shall be treated as **Work In Progress** or shared as un-controlled documents until such time as they leave the BIM environment in a non-editable format.

Only those drawings which it has been deemed necessary to revise will be re- issued following modification work.

> **Note:**
> At this stage of the industry‟s adoption of BIM, contract deliverable will, in general, be a 2D drawing. Issuing of BIM data to external organisations shall be issued with a disclaimer „**ISSUED FOR INFORMATION ONLY**‟. No liability is implied for such data and how it is subsequently utilised

4.5 CDE Phase 4: Archiving

Archiving of all output data from the BIM shall be stored in the Archive section of the project folder, including published, superseded and „As Built‟ drawings and data.

Additionally, at key stages of the design process, a complete version of the BIM data and associated drawing deliverables shall be copied into an archive location.

Archived data shall reside in logical folder repositories that clearly identify the archive status *e.g. 09-12-11 Stage D Design.*

4.6 Validation

Sheets from the BIM shall be published to DWF (preferred), PDF or other non- editable format, where they can be checked, approved, issued and archived as traditional documents.

Validation of the BIM data prior to sharing shall check that:

All drawing sheets and extraneous views shall be removed from the BIM;

Model file has been audited, purged and compressed;

File format and naming conventions conform to project Data Exchange protocols,
Data segregation conforms to the agreed project BIM methodology,

Model files are up-to-date, containing all users‟ local modifications,

Model files are detached from central file,

Any linked reference files have been removed and any other associated data required to load the model file is made available,

Model is correctly assembled through visual inspection,

Any changes since the last issue are communicated to the project team.
Any Family developed or downloaded needs to be validated prior to adding it to the 'BIMARABIA Library'.

Validation is the process of checking the modeling results for compliance. The validation goals are finding out whether the model conforms to EIR and company standards, is accurate, optimized and complete, supports seamless identification and extraction of information from the BIM-model elements, is free of collisions and so forth.

General quality control strategy

The BIM Manager/Coordinator shall develop and implement the quality control system for BIM models based on regular inspections and coordination meetings.

The quality control system shall be based on an agreed set of rules, requirements and procedures of this standard.

Each BIM author shall be responsible for the quality of information models in his/her design discipline.

Various kinds of inspection

Validation should be conducted in the following areas or their combinations:

- checks of the spatial position and geometrical parameters,
- checks of data,
- 3D coordination checks.

All checks are carried out either in the manual mode (visually) or in an automated way using a variety of software (Autodesk Revit, Autodesk Navisworks, Microsoft Excel and others).

Checks of the spatial position and geometrical parameters shall include:

- Verification of model elements' compliance with the LOD requirements (geometric component).
- Excessive and insufficient levels of development are identified.
- Checking for conformity between the coordinate system and the base file.
- Checking the accuracy of model elements (analysis of elements' junctions).
- Checking the absence of duplicated and overlapping elements.

Such inspections are recommended on a weekly basis, but this may vary depending on the particular project.

Checking of data is needed to determine to what extent the data is systematized, classified and structured in accordance with the requirements of this standard and a specific project. The latter shall be recorded in the BEP. The checking shall be conducted on a weekly basis.

Recommended checks are listed in Appendix D, "Model Validation Checklist".

Before the model file is placed in the published data area, it shall be disconnected from the repository file, and all unused elements and links shall be purged.

3D coordination checks

Checking for spatial conflicts shall be performed in order to find and resolve any potential collisions between model elements in the design phase, thus preventing them on site.

It's recommended to do this in Autodesk Navisworks Manage.

Collision checking assumes:

- Creation of an aggregated model (if interdisciplinary inspection is carried out).
- Definition of the checks to be carried out, and the requirements for their successful completion.
- Making checks and creating the collision log (see Appendix C, Table C.1), appointment of people responsible for their resolution.

Using search sets is recommended when checking for collisions.

The BIM Manager/Coordinator has the responsibility for carrying out collisions checks.

BIM coordination meetings

Coordination meetings shall be held in order to analyze found collision, look for the ways of their resolutions and appointment of responsible persons. Leaders of all relevant groups/departments/disciplines, the BIM Manager(s)/Coordinator(s) and the project manager

shall participate.

Coordination meetings are held as appropriate. They include discussing the general issues of the implementation of BIM project, as well as issues related to collisions identified during inspections. In particular, discussions cover the progress of the project in the modeling context, location of participants and their tasks, backlogged tasks identified at the previous meeting, matters of collective interaction, unresolved technical problems, amount of work on the contract and compliance with the BEP, validation and finding solution for the identified conflicts, appointment of professionals responsible for resolution, need for additional resources.

Coordination meetings can be combined with other meetings, devoted to the implementation of the project based on BIM.

Validation Checklist:

Geometric Definition:
- Geometry accuracy, size and simplicity
- Constraints Behaviour
- Parametric Definitions (Properties, Formulas...etc)

Visibility:
- Visibility in different views
- Standard Fonts, Colours

In Project:
- Reaction with Host / Connectors
- Appearance in Schedules

Categorization:
- Family Category and Parameters
- Family Types

Naming Conventions:
- Parameters Naming and Grouping
- Shared Parameters File
- Family Name
- Family Types Names
- Location in Library Tree

4.7 Data Security & Saving

All BIM project data shall reside on network servers which are subject to regular back-ups.
Staff access to BIM project data held on the network servers shall be through controlled access permissions.
Maximum number of Revit back-ups shall be set to 3.
Revit LOCAL files shall be saved back to CENTRAL hourly.
Revit save reminder interval shall be set to 30mins.
A „Splash Page" is included in the associated templates. These shall be retained and the file information completed. The note may be discarded or replaced with project-specific information if required.
Users shall open the Splash Page view and close all others when saving in order to improve the efficiency of file opening.

4.8 Project Issue Logging and Resolution System

Coordination discrepancies discovered during the collaboration review process shall be logged and managed. These issues shall be communicated to the relevant parties in a report which provides the following as a minimum:
Specific location of any clash, including 2D and 3D images where possible
Element ID"s of the objects in question, where relevant

A detailed description of the problem
Details of the date/revision/origin of the linked information being cross-referenced

Suggested solutions or actions to be taken, by whom and by what date Author

of the issue and the distribution list for information or resolution Confirmation

that the resolution has been tested in the model

Issue status – pending response / overdue / unsuitable response / closed

Items with an unsuitable response shall be re-logged as a new issue to avoid confusion over whether the issue has been resolved. The original issue shall then refer to a new issue number.

Outstanding issues shall be discussed at the project co-ordination meetings. This process may be aided by using Navisworks on larger projects to keep the 3D information manageable.

4.9 Reviewing BIM Data

Untrained users shall not open Revit models directly. Instead, the model shall be exported as a 3D DWF and the freely available Autodesk Design Review software shall be used for interrogation and mark-up.

4.10 Data Exchange Formats and Interoperability

BIM model is an ideal platform for sharing data on the building object.

Interoperability between software products is of paramount importance for successful BIM working. File protocols ensure such an interoperability.

General rules of data transfer

Data exchange formats and rules (protocols) shall be agreed by all BIM project participants and formalized in the BEP.

Requirements and limitations of the target software/hardware system shall be understood in order that BIM data can be prepared appropriately for exchange.

Data exchange protocol between different software/hardware systems shall be verified through sample testing to ensure data integrity is maintained.

Prior to export / import data, it's necessary to purge all the excess information that could destabilize the data structure.

The appropriate export layer tables shall be used during export to CAD.

Exchange formats for Autodesk Revit platform

Table 1 shows the recommended exchange formats for Autodesk Revit platform and their most frequent usage methods.

Table 2 contains a partial list of formats supported by Autodesk Revit.

This standard does not restrict use of other formats, taking the common rules into account (see section 6.1).

Table 1. Recommended exchange formats for Autodesk Revit platform

<table>
<tr><th rowspan="2">Format</th><th colspan="2">Application methods</th></tr>
<tr><th>For data export</th><th>For data import</th></tr>
<tr><td rowspan="2">RVT</td><td>Data exchange within Autodesk Revit platform</td><td rowspan="2">Data exchange within Autodesk Revit platform</td></tr>
<tr><td>Data transfer to Autodesk Navisworks</td></tr>
<tr><td rowspan="2">DWG</td><td rowspan="2">Export of views and sheets to AutoCAD and other CAD software</td><td>Import of DWG layout from AutoCAD and other CAD software</td></tr>
<tr><td>Import of contours, surfaces (3D faces), corridors and pipes from AutoCAD Civil 3D</td></tr>
</table>

ADSK	Export of data (model objects) to AutoCAD Civil 3D	Import of objects (for family creation) from Autodesk Inventor
IFC	Export of data to third-party software that supports model import in IFC format	Import of data from third-party software that supports model export to IFC format
DWF/3D DWF	Export of data for review and publishing	Import of annotations and markups from Design Review to Revit and AutoCAD
PDF/3D PDF	Export of data for review and publishing	–
FBX	Export of models to 3ds Max	–
SKP	–	Import of data from Trimble SketchUp
SAT	Export of 3D data	Import of 3D data

Exchange formats for AutoCAD Civil 3D

Design development assumes creation of BIM models that comprise sets of data corresponding to the goals and objectives of the specific project stages and phases.

Various design stages require using of different levels of detail (LOD) in the model.

Basic Rules of BIM Data Exchange

- Validation of the BIM data prior to sharing shall check that:
- File format, Revit version and naming conventions conform to the corporate BIM Standard.
- Elements used in the model correspond to data classification according to Revit categories, or to the corporate classification (coding) system of structural components and building systems.
- Model files are up-to-date, containing all users' local modifications.
- Model files are detached from central file.
- Any associated data required to load the model file is made available.
- Model file has been audited, purged and compressed.
- Any changes since the last issue are communicated to the design team.

5 Interoperability

5.1 Introduction

Interoperability between software products is of paramount importance for successful BIM working. Whether it is output to 2D CAD for subsequent drawing production or output for 3D visualization or analysis, the preparation and methods adopted to compose the BIM will ultimately determine its successful application within other software packages and technologies.

5.2 Incoming CAD/BIM Data Management

All incoming CAD/BIM data shall be logged in accordance with the project‟s data management procedures.

A copy of incoming CAD/BIM data shall be stored in its original format within the project Incoming sub-folder.

The project BIM Co-ordinator shall verify the suitability of incoming data prior to making available project-wide through the project Shared area.

Modifications of incoming CAD/BIM data shall be kept to the absolute minimum and only be carried out where the received data format prevents design progress.

Modifications shall only be carried out with the approval of the project BIM Co-ordinator.

Data shall be cleansed prior to importing or linking to the BIM model to remove any irrelevant or extraneous data which may destabilise the BIM database.

CAD data may need be shifted to 0,0,0 prior to import – see section 7.4.

Details of the changes made in cleansing a file shall be fully documented in the Project BIM Strategy.

Ownership of this cleansed data is transferred from the originator to the cleansing discipline. Cleansed data is stored within the discipline‟s **WIP** area unless deemed appropriate to share project-wide, in which case it is stored in the Shared area.

Responsibility for ensuring that cleansed data is current lies with the party making the modifications.

5.3 Fit For Purpose Modelling

BIM data shall be prepared „fit for purpose", taking into account the requirements of any recipient software applications, to ensure that error free, reliable data is exchanged (e.g. link to analysis packages or interface with GIS).

> **Example:**
> When modelling structural frames, some analysis software may dictate that columns need to be stopped at each floor level regardless of whether, in reality they continue as a single length.

5.4 Data Transfer between Packages

Prior to data transfer between packages, the following tasks shall be carried out:

Requirements and limitations of the target software/hardware system shall be understood in order that BIM data can be prepared appropriately for exchange.

2D output from the BIM shall be constructed in a manner that is usable to the team, reasonably complies with project CAD Standards, and allows easy manipulation of the data held within the file, e.g. layering.

Data exchange protocol between different software/hardware systems shall be verified through sample testing to ensure data integrity is maintained.
The appropriate export layer tables shall be used during export to CAD

6 Data Segregation (worksets & linking)

6.1 General Principles

A number of methods exist which enable collaborative working in a BIM environment, including working practices and team management as well as the technological solutions covered by the remit of this document.

This section deals with the principles of subdividing a model for the purposes of:

- multi-user access,
- operational efficiency on large projects,
- inter-disciplinary collaboration.

The terminology refers primarily to the Revit subjects of **Worksets** and **Linking** (sections 6.2 & 6.3), both of which are referred to herein as model sub-division. The following practices shall be followed:

The methods adopted for data segregation shall take into account, and be agreed by, all internal and external disciplines to be involved in the modelling.
In line with the model development methodology described in section 7, models shall initially be created as isolated, single-user files. The model will be sub- divided as it becomes larger or additional members of the design team are introduced.

No more than one building shall be modelled in a single file.

A model file shall contain data from one discipline / project stakeholder only(although exceptions may apply for Building Services where multiple disciplines converge).

Further segregation of the geometry may be required to ensure that model files remain workable on available hardware. (As a basic guide, files exceeding 50MB shall be reviewed with respect to performance and possible further sub- division. Ideally files shall not exceed 100MB; for projects containing more than 1200 sheets within a single project, the performance of the „synchronize with central‟ will dramatically decrease).

In order to avoid duplication or co-ordination errors, clear definition of the data ownership throughout the life of the project shall be defined and documented. Element ownership may transfer during the project time-line – this shall be explicitly identified in the Project BIM Strategy Document.

Where multiple models make up a single project, a container model should be considered,

whose function is to link the various assemblies together for coordination/clash detection purposes.

Example of Data Segregation:

	Breaks in Design *(Linking or Worksets)*
Architecture	Floor by floor or groups of floors
Structure	Major geometry splits such as east-wing or west-wing
Mechanical	Construction joints such as podium and tower
Electrical	Work packages and phases of work
Civil	Document sets
	Work allocation such as core, shell and interiors

6.2 Worksets

Worksets allow multiple users to simultaneously work on a model file through use of a CENTRAL file and synchronised LOCAL copies. Properly utilised, worksets can significantly improve efficiency and effectiveness on large and multi-user projects.

Appropriate worksets shall be established and elements assigned, either individually or by category, location, task allocation, etc.

To improve hardware performance only the required worksets shall be opened. Revit ensures that elements contained in closed worksets are still updated if changes made in open Worksets impact them during model regeneration.

6.2.1 Division

Workset allocation shall be done in a logical manner that allows for other members of the design team to collaborate and/or assist with the model development without recourse to complicated introductions to the project methodology.

A project shall be broken into a sufficient number of Worksets to avoid congestion in workflow. This also provides the means for adequate control over the efficiency of the model.

The BIM Co-ordinator shall define how the model is split into worksets, such as described in the above table.

The BIM Co-ordinator shall manage the borrowing permissions and workset ownership. Worksets shall be named following the conventions defined in section 8.5.

6.2.2 Saving on Multiuser Projects

All team members shall „Save to Central" hourly.

The Project BIM Co-ordinator shall allocate a pre-defined, unique slot for each team member to „Save to Central". This avoids machines hanging whilst several users try to save simultaneously.

The "Work-sharing Monitor" tool could be used to coordinate „Save to Central" commands across the team.

Users shall not leave the save to central process unattended, and shall resolve any issues which arise to avoid delays to other team members.

Borrowing or Workset Ownership

Two methods exist for setting permissions which enable multi-user access to a model file through use of worksets:
Two methods exist when using worksets to enable multi-user access to a model file: „borrowing elements" and „owning worksets". Typically, „**borrowing**" shall be used. However, „**ownership**" shall be used when:
Restricting access of a particular aspect of the building to a single user,

A user needs to operate away from the network and still be able to work, although caution is required to ensure that only „owned" worksets are edited,

Working collaboratively over a slow or remote network.
In practice, these methodologies take the following form:

Element Borrowing

Users work as though in isolation on a single-user file.

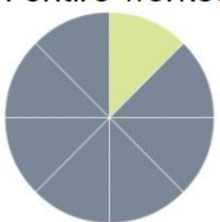
Permission to modify an element is sought and either given or denied by a live link to the Central file.

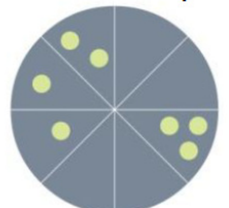
All permissions collated in this manner are relinquished during the „Save to Central" process.

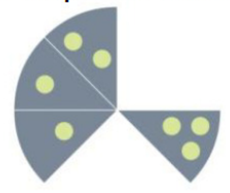
Workset Ownership

A user takes ownership of an entire workset.

The LOCAL file does not need to query the CENTRAL file for permission to modify any element allocated to that workset.







6.3 File Linking

Linking enables additional geometry and data to be referenced into a model. This may be either other parts of a project which are too big to manage in a single file, or data from another discipline or external company.

6.3.1 Single Discipline Linked Files

Some projects require that models of single buildings are split into multiple files and linked back together in order to maintain manageable model file size.

In some large projects it is possible that all the linked models may never be brought together as one. Various container files will exist to bring model files together for different purposes.

Task allocation shall be considered when dividing the model so as to minimise the need for users to switch between models.

Division shall be determined by the lead architect / engineer in conjunction with the

BIM Co-ordinator.

How and when the model is split shall be defined in the Project BIM Strategy document.

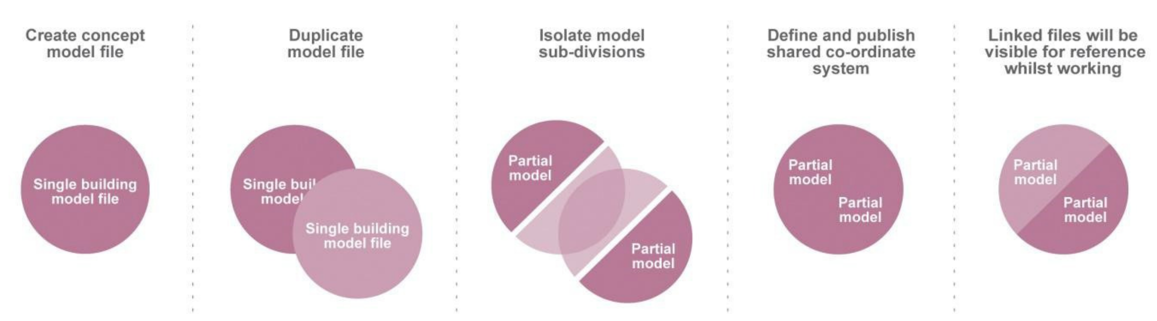
Model Lines shall be used to create cross-hairs in open space prior to duplication of the model. They then serve as a quick-check to ensure that the sub-models are aligned after Linking.

When first linking the models back together, „**Origin to Origin**" shall be used as the insertion mechanism.

Before split and linked models are shared with the rest of the team:

- The real-world co-ordinates of a point on the project shall be defined and published to all linked models using the „Shared Coordinate" tools in Revit,
- Each sub-model shall be reopened and the other sub-models Linked in as required using the „**By Shared Coordinates**" insertion method.
- The relationship between True North and Project North is correctly established.

When splitting a file into sub-models the below workflow shall be followed:



6.3.2 Inter-Disciplinary Model Linking

Each separate discipline whether internal or external, involved in a project shall have its own model and is responsible for the contents of that model. A discipline can Link in another discipline"s Shared model for reference.

Shared Coordinates and Project North rotation shall be agreed and documented at the outset. No deviation from these shall occur without permission of the BIM Co- ordinator.
Details of any discipline-specific requirements, such as the difference between Finished Floor Level (FFL) and Structural Slab Level (SSL), shall be fully documented in the Project BIM Strategy.

The Copy and Monitor tools in Revit shall be used to duplicate and relate Levels and Grids only.

The Copy Monitor tools shall not be used for other element categories without a full understanding of limitations, such as the creation and update of certain elements is not reflected in the monitoring process.

Ownership of elements shall be properly communicated and tracked through the project time-line (e.g. floors may be created by the Architectural team, but are then adopted by the Structural team to form part of the load-bearing structure).

Each discipline shall be conscious that referenced data has been produced from the perspective of the author and may not be modelled to the required specification for other purposes. In this case, all relevant parties, with input from the BIM Manager(s) shall convene to discuss the potential re-allocation of ownership.

Should a team develop a „starter model" for a partner discipline, such as defining the structural model in conjunction with the architecture, this shall be done in a separate model which shall then be linked in.

This starter model may be passed to the partner discipline who shall then assume ownership of it. The partner discipline shall open this starter model and link in, by shared co-ordinates, the originator"s model as a reference.

With models produced for Building Services, several disciplines may be collated in a single model, as a single piece of equipment may require connection to various services. In this scenario, the model may be split in various ways. The BIM Co- ordinator shall be consulted in defining the project-specific strategy.

Project Release

This standard assumes that design documentation is created directly from the BIM model.

Project release is the process of preparation to delivery in the following formats:

- electronic design documentation, PDF or DWF,
- model(s), RVT,
- aggregated model, NWD.

Project release also includes publishing and archiving.

The following shall be observed for the design documentation:

- Publishing design documentation in PDF format is carried out by sending the annotated sheets to a virtual PDF printer.
- Publishing design documentation in DWF format is carried out by exporting the annotated sheet sets (*Application Menu>Export>DWF/DWFx*).

❖ Preparing the model to publishing/archiving

The following recommendations shall be observed for publishing/archiving:

- Model shall be archived before each checkout at any design stage.
- Unneeded and unused elements shall be purged from the model before archiving.
- If there are linked files they shall be included with the model itself.
- eTransmit extension, freely available to Revit subscribers, is recommended for model archiving:

https://apps.autodesk.com/RVT/en/Detail/Index?id=appstore.exchange.autodesk.com%3aetransmit_windows64%3aen

eTransmit extension collects into a single archive all model-related files, i.e. the main design file and all other linked RVT, DWG and DWF files.

- How to use eTransmit:
  - Make sure that all models are closed.
  - Launch *eTransmit* and specify the target folder for collecting all model-related files.
  - After *eTransmit* is completed, check the integrity of the design file by opening it in the target folder.
  - Move the contents of the target folder to the archive folder.
  - Deliver the contents of the target folder to building owner or any other stakeholder by the appropriate means (email, cloud service, FTP, publishing in the recipient's electronic document management system, etc.

7 Modelling Methodology

This section defines the methodologies for BIM working that enables efficient use and re-use of BIM data.

7.1 Model Development Methodology

Standard templates have been created to facilitate, a Model Development Methodology which shall be used to develop projects in early stages as it enables rapid model development and allows for very large models to be created with low hardware requirements.

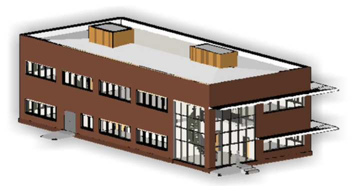
The templates provide only one example of each element, such as „Doors". These concept (Grade 1 - *see section* 7.2) elements shall be used to form categorised place-holders in the model.

As the design develops, and precise materials and components are chosen, these concept objects shall be swapped, individually or en-masse, for more specific Grade 2 or Grade 3 variants.

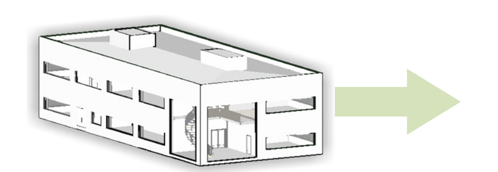
For Structural Analytical components, sample columns and framing members which are representative of steel or concrete elements shall be provided in the template.

The frame shall be constructed from these placeholders. If the section size is known from an early stage it can be chosen from the libraries, but no assumptions shall be made by opting for the default section.

EXCEPTION for MEP System components. Errors can occur in swapping one MEP system component for another and so the above methodology shall be used only on components which are not system related.



Concept components substituted for Grade 2 or 3 components as design progresses.



Model initially created using concept grade components.

7.2 Levels of Detail:

BIM model development methodology makes it possible to use elements with low level of detail (LOD) in the early stages of design.

Such elements only need to fill the desired size, and they can be used until the definition completes. Elements gradually become more detailed and obtain more geometric attribute components (more LOI), i.e. are transferred from lower to higher LOD.

The implementation of the LOD concept is accomplished by means of standards (LOD specifications) of sequential transformations (progressions) for representation of BIM model elements. Along with this, matrix of correspondence between level of detail and project stages is formalized. These procedures regulate the requirements for LOD (G) and LOD (I) for various design disciplines. Basic LOD specification and sample matrices for the main design disciplines are listed in Appendix A.

Using elements with predetermined LOD allows determining the expected BIM content on the component level at different design stages and provides the ability to control BIM project execution.

The following shall be taken into account during the BIM model development:

- Elements with lower level of detail (LOD 100 or LOD 200) can be used for design concept studies.
- Elements with higher level of detail (LOD 300 or LOD 400) can be used in later design stages.
- LOD matrix is necessary in order to unambiguously understand requirements for all design levels and disciplines.

7.1.1 LOD-based Development of Model Components

The following main principles shall be observed when creating and using the design components:

- All components shall reside in the library of the specific project or in a central company library.
- Components generated during the design development will be stored in the WIP area of the Common Data environment.
- The intended purpose of the components shall be considered during content creation.
- The BIM Manager/Coordinator will assess and verify minimum quality compliance before submitting new objects to the central corporate library.
- Components shall be developed with the LOD required at the particular stage of design process.
- Components of the information model shall be created with the minimum necessary geometrical information. The less 3D geometry the information model contains the faster and easier it will be handled.

- Autodesk Revit allows creating and using families that make use of Coarse, Medium and Fine levels of detail.

- Further purposes of the BIM will lead to additional specifications of the content, which should be built to suit the purposes of the deliverables. Information can be added to the existing components either by means of creation of shared parameters and their assignment to specific categories of elements within the design itself, or by separate addition of these parameters to each library component. Method that is to be used shall be defined in the BEP.

- A corporate shared parameter file is encouraged in order to maintain consistency of variable naming during content creation. Where multiple LODs of the same component do exist, care should be taken to ensure that the same Shared Parameters are incorporated into the objects, in order to maintain data integrity.

Detailed definitions of various LODs are in the Appendix A to this Standard.

7.1.2 Using 2D Elements for the 3D Model Detailing

The information modeling process allows the use of plain drawings to complement the BIM-model with all necessary information.

The particular BEP shall dictate the point at which intelligent 2D detailing begins to be utilized to prepare the published output.

Detailing and enhancement techniques shall be used whenever possible to reduce model complexity, but without compromising the integrity of the model. Detailing is carried out by using Revit ribbon *Detail* panel.

7.1.3 Work with DWG Drawings

When working with 2D content originating from other software (such as AutoCAD DWG drawings), consider the following recommendations:

- Avoid using CAD drawings in Revit as details. They must first be converted into Revit objects. If the use of CAD drawings cannot be avoided, these files should be linked rather than imported.

- If there are linked 2D drawings in the model, team members that are responsible for the sheet compilation shall make sure that all information in these drawings is verified and approved and that it is inserted into the design directly from the CDE Shared area.

- Unnecessary elements shall be purged from the CAD files; files shall be audited then.

- Avoid CAD files that contain proxy objects and SHX fonts.

- Make sure that XRefs are minimized in the CAD file. XRefs shall be attached before inserting them into the design.

- Existing library of standard 2D details shall be converted from DWG to RVT format.
- Use of CAD files needed to support the final documentation shall be minimized where possible.

7.1.4 Drawing Compilation

Drawing compilation and preparation for publication can be carried out in two ways:

- Fully assembled compilation of views and sheets within the BIM environment (preferred)
- Export views in the form of output files for assembly and graphical enhancement using 2D detailing tools within a CAD environment. Such a way is not covered by this standard and should be avoided where possible.

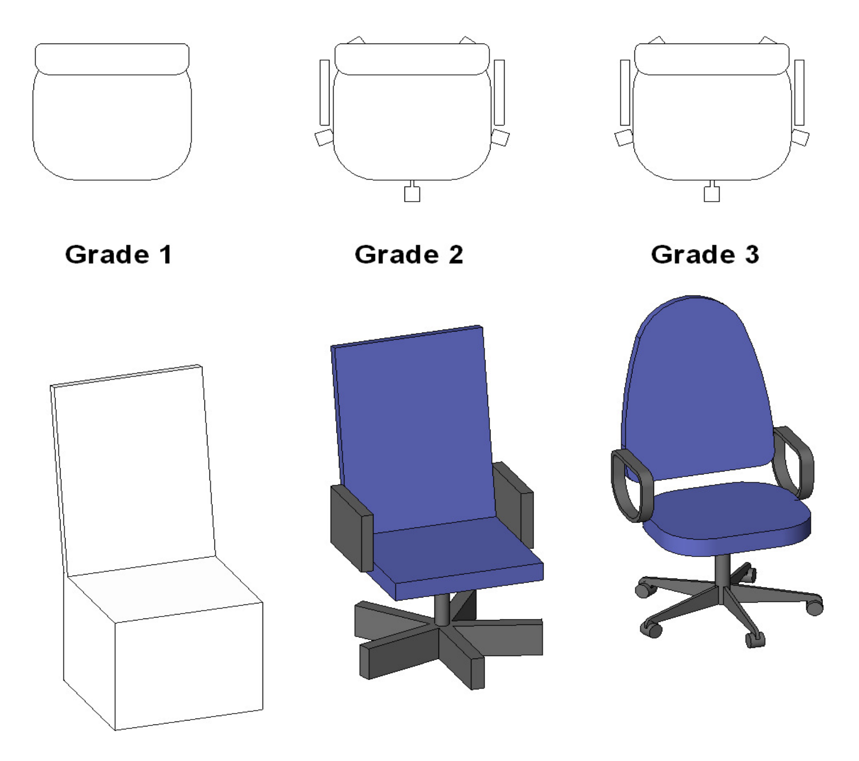
Sheet composition direct from within the BIM

Drawing sheet composition from within a BIM environment shall be established through the linking of views, callouts and elevations to drawing sheets fully within the BIM authoring software.

Care shall be taken to ensure that any referenced data is available and visible prior to the publication of documentation.

7.2 Graded Component Creation

In line with the Model Development Methodology, all components created, or otherwise obtained shall be graded, named and stored accordingly in the project or central folder structure. Elements shall be graded as follows:



Component Grade 1 – Concept

Simple place-holder with absolute minimum level detail to be identifiable, e.g. as any type of chair.

Superficial dimensional representation.

Generic in terms of manufacturer information and technical data.

Created from consistent material: either „Concept–White" or „Concept–Glazing".

Component Grade 2 – Defined

Contains all relevant meta-data and technical information, and is sufficiently modelled to identify type of chair and component materials.

Typically contains level of 2D detail suitable for the "Preferred" scale.

Sufficient for most projects.

Component Grade 3 – Rendered

Identical to the Grade 2 version if scheduled or interrogated by annotation. Differs only in 3D representation.

Used only when a 3D view at a sufficient scale deems the detail necessary due to the object"s proximity to the camera.

Important!

> Components may appear more than once in the library with different grades and the naming must reflect this.
> When in doubt, users should opt for less 3D geometry, rather than more, as the efficiency of the BIM is largely defined by the performance of the components contained within.

Adherence to the above grading and Model Development Methodology may result in multiple versions of the same element existing at different grades. This is accommodated in the object naming strategy defined in Section 8.6.

Further purposes of the BIM will lead to additional specifications of the content, which should be built to suit the purposes of the deliverables.

In addition to the grading, a component may make use of Coarse, Medium and
Fine levels of detail to control graphical representation.

Objects generated in the development of a project will be stored in the WIP area of the project folder structure.

The BIM Co-ordinator will assess and verify minimum quality compliance before submitting new objects to the corporate library stored in the central resource folder.

The intended purpose of the components shall be considered and the results checked and verified prior to large scale use. For instance, structural analysis applications may require elements with certain naming conventions or other criteria, without which they will not be recognised. Different applications may have different requirements.

A corporate shared parameter file is encouraged in order to maintain consistency of variable naming during content creation. (Refer to Section 10.5)

Where multiple grades of the same element do exist, care should be taken to ensure that the same Shared Parameters are incorporated into the objects, in order to maintain data integrity.

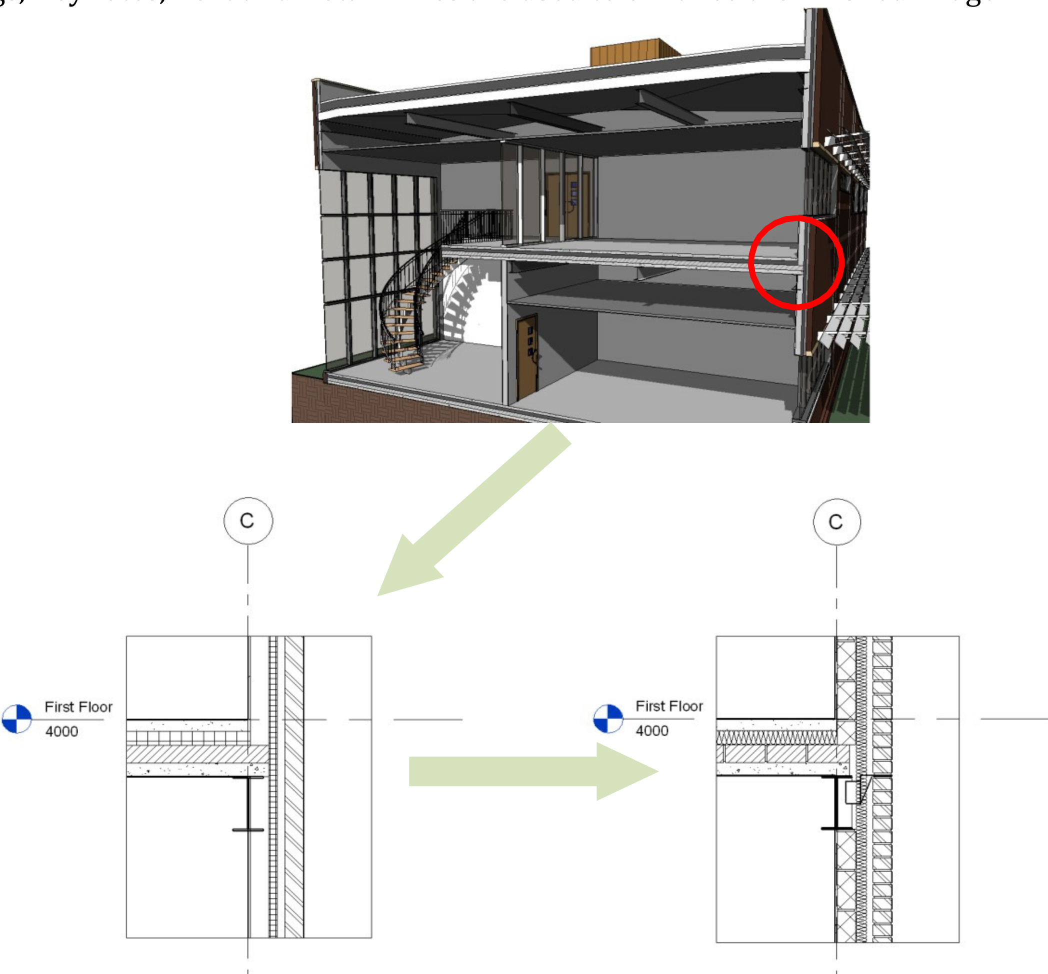
7.2.1 Model / Drafting Detail

At the outset of the project, consideration shall be given to the maximum level of detail to be included in the BIM. Too little and the information will not be fit for purpose; too much and the model may become unmanageable and inefficient.

The BIM Co-ordinator shall dictate the point at which 3D geometry ceases and 2D detailing is utilised to prepare the published output.

Intelligent 2D linework shall be developed to accompany the geometry and enhance the required views without undue strain on the hardware. 2D linework is not exclusive to detailed/fabrication information.

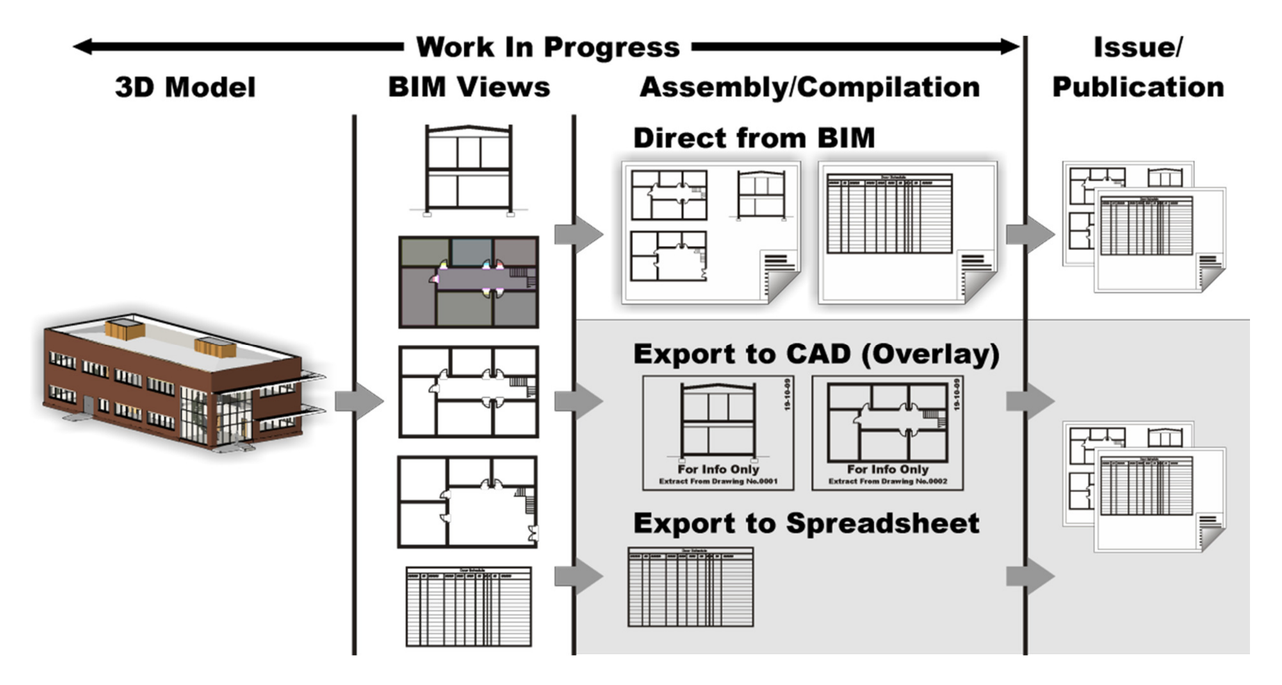
Detailing and enhancement techniques shall be used whenever possible to reduce model complexity, but without compromising the integrity of the model.
3D modelling is carried out to an accuracy of approximately 1:50
2D information contained within model Detail Components, Repeating Details, Filled / Masking Regions, Tags, Keynotes, Text and Detail Lines are used to enhance the finished image



7.3 Drawing Compilation

Drawing compilation and preparation for publication can be carried out in two ways:

1. Fully assembled compilation of views and sheets within the BIM environment (preferred).
2. Export views in the form of output files for assembly and graphical enhancement using 2D detailing tools within a CAD environment.



Exporting views in order to „finish off" in CAD negates the advantages of the BIM data for coordination purposes and should be avoided where possible.
The BIM Co-ordinator shall decide if the team composition or other factors dictate that the BIM methodology is not appropriate.

Whichever methodology is chosen, the 3D model shall be developed to the same maximum extent, before 2D techniques are applied.

When CAD or BIM data is Linked into a project, the design teams shall ensure that the latest validated / checked design information is accessed directly from the Project Shared area when composing drawing sheets.

7.3.1 Sheet composition direct from within the BIM

Drawing sheet composition from within a BIM environment shall be established through the linking of views, callouts, elevations and drawing sheets fully within Revit software.
Care shall be taken to ensure that any linked data is available and visible prior to the publication of documentation from the BIM.

7.3.2 Sheet composition from Views/Output files

Views exported from the BIM for sheet compilation in CAD, or for use as a background to other drawings in CAD, shall be placed on a plain border which clearly indicates the following:

The data is provided for information purposes only

Details of the origin of the data

The date of production or issue

Where output files are exported from the BIM for further 2D detailing in CAD, originators shall ensure that changes occurring within the BIM are correctly reflected and updated within the CAD files used to produce the final drawing.

If it is a requirement to export data from Revit in „Real-World" co-ordinates, then the export operation must be performed from a working view (such as a floor-plan) and not from a compiled sheet view.

> **Warning:**
> The integrity of exported views/output files from within a BIM environment must be checked for accuracy and content prior to drawing compilation.

7.4 Spatial Location & Co-ordination

As defined in **BS1192:2007**, BIM projects shall:

Use real world co-ordinate systems:

Be produced to true height above project datum.

Adopt the established Project Shared Coordinate system across all BIM data files to allow them to be referenced without modification.

CAD data modelled more than 1 mile from the origin (in any plane) shall be shifted to 0,0,0 prior to importing into Revit to avoid accuracy issues. This shift shall be agreed, consistent and identified in the Project BIM Strategy document.

> **Note:**
> Some software (e.g. certain structural analysis software) requires data to be located at 0,0. For export to such software, alternative coordinate systems shall be established within the BIM data.

7.5 Units and Measurement

Models shall use consistent units and measurement across the project. Default **project units** shall be millimetres with two decimal places in order to display accuracy in the temporary dimensions.

Dimension styles in the accompanying templates utilise defined units which override project settings, so whilst the temporary dimension might read **3000.00** *(project settings)*, the permanent dimension will read **3000** *(dimension style in template)*.

2D input/output files shall conform to the unit and measurement protocols designated for specific drawing types e.g.

- **1 unit = 1.000 metre** Site layout drawings relating to the project coordinate system to an accuracy of 3 decimal places.
- **1 unit = 1 millimetre** Elements, details, sections, elevations and building structure outlines to an accuracy of 0 decimal places.

Switching between Imperial / Metric units shall be avoided where possible in order to maintain proper or conventional measurements, such as 50mm rather than 50.8mm.
CAD data shall be scaled to the appropriate units prior to linking into the BIM environment.

8 Folder Structure and Naming Conventions

8.1 Introduction

This section defines storage of BIM data within the project filing system along with the naming conventions associated with aspects of BIM working.

8.2 Project Folder Structure

The defined structure follows the principles of **BS1192:2007�because s** „Work In Progress (WIP)‟, „Shared‟, „Published‟ and „Archived‟ segregation of data within a designated set of folders (see section - Project Review Dates: Sets out key dates for reviews of the Revit model which all teams buy in to (both internal to the company and externally with the full design team).

Collaborative BIM Data Sharing).

Where a project comprises of a number of separate elements such as multiple buildings, zones or areas, the BIM structure shall be maintained within a set of designated sub-folders representing the various project elements.

All project data (with the exception of a user‟s Local copy of a Central file) shall be held within the standard project folder structure located on central network servers or appropriate Document Management technology. This includes all WIP components or assemblies.

8.2.1 Central Resource Folder Structure

Standard templates, titleblocks, families and other non-project-specific data shall be held within the server based Central Resource Library, with restricted access.

- <SERVER NAME>\Resource\Autodesk_Revit
  - + Titleblocks
  - + Standards
  - + Templates
  - + Families [Refer to Section 8.2.4]

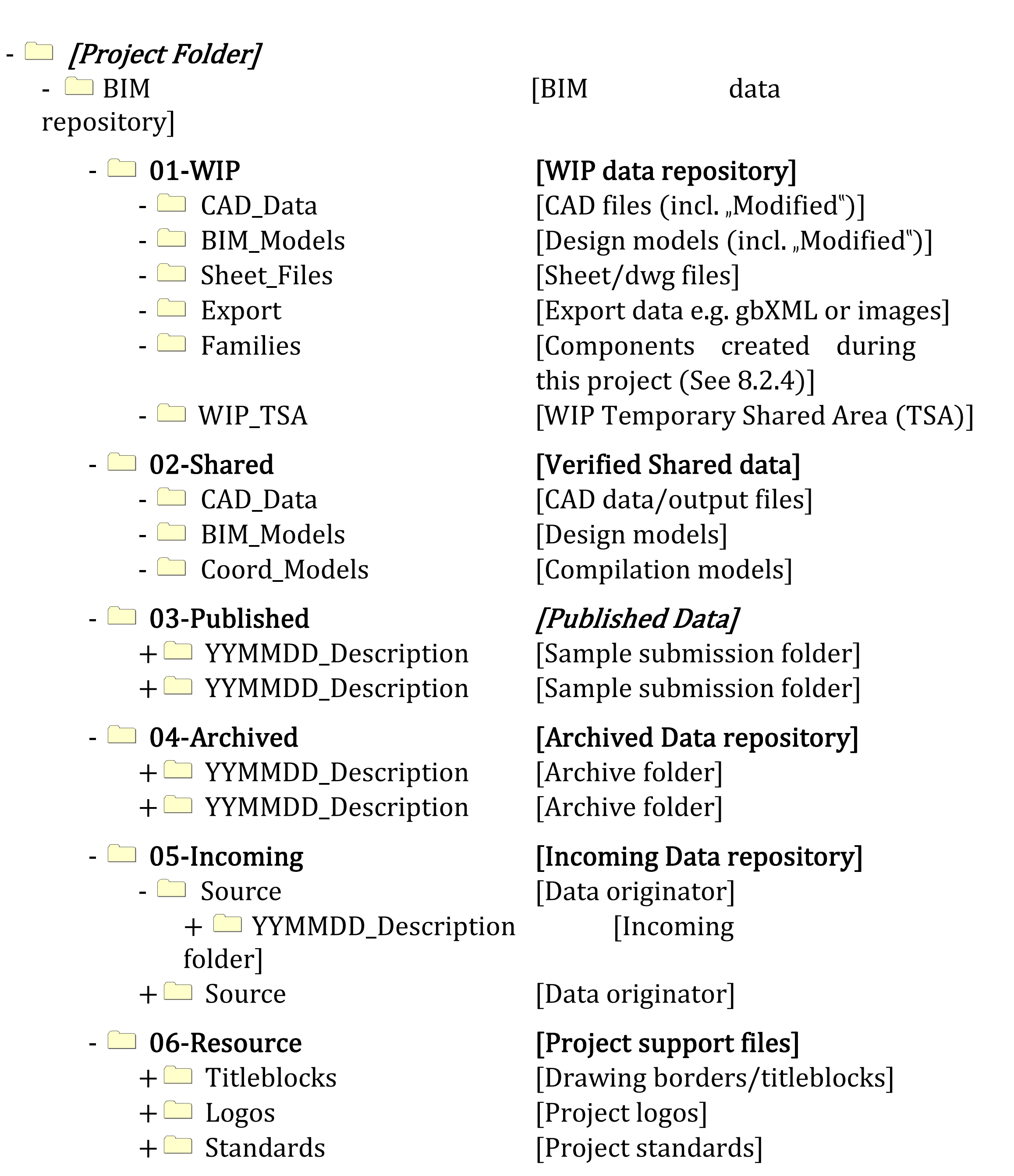
8.2.2 Local Project Folder Structure

Local copies of central project models do not need to be backed up as changes are regularly synchronized with the central model. They shall be stored on the user‟s hard drive – **not in „My Documents‟**– according to the folder structure below.

Folder	Description
- D:\	[Standard local drive]
- BIM_Projects	[Storage of Revit local projects]
- <Project Name>	[Name of project]

8.2.3 Project Folder Structure

The following folder structure is provided as an example arrangement, designed to encourage compliancy with the strategies contained within this standard.



Folder	Description
- *[Project Folder]*	
- BIM	[BIM data repository]
- **01-WIP**	**[WIP data repository]**
- CAD_Data	[CAD files (incl. „Modified")]
- BIM_Models	[Design models (incl. „Modified")]
- Sheet_Files	[Sheet/dwg files]
- Export	[Export data e.g. gbXML or images]
- Families	[Components created during this project (See 8.2.4)]
- WIP_TSA	[WIP Temporary Shared Area (TSA)]
- **02-Shared**	**[Verified Shared data]**
- CAD_Data	[CAD data/output files]
- BIM_Models	[Design models]
- Coord_Models	[Compilation models]
- **03-Published**	***[Published Data]***
+ YYMMDD_Description	[Sample submission folder]
+ YYMMDD_Description	[Sample submission folder]
- **04-Archived**	**[Archived Data repository]**
+ YYMMDD_Description	[Archive folder]
+ YYMMDD_Description	[Archive folder]
- **05-Incoming**	**[Incoming Data repository]**
- Source	[Data originator]
+ YYMMDD_Description	[Incoming folder]
+ Source	[Data originator]
- **06-Resource**	**[Project support files]**
+ Titleblocks	[Drawing borders/titleblocks]
+ Logos	[Project logos]
+ Standards	[Project standards]

No spaces are to be used in the folder naming as this can potentially interfere with certain file management tools and collaboration across the internet.

8.2.4 Component Library Sub-Folders

All locations for the storage of Family components shall be sub-divided as follows:

- ***Families***	***[Exists in several locations]***
+ 2009	[The version of the software]
- 2010	[The version of the software]
- Architecture	[Architectural components]
- Mechanical_Services	[MEP components]
- Structure	[Structural components]
- General	[Non discipline-specific elements]
- Autodesk_Metric_Library	[Default supplied components]
- Material_Library	[Textures libraries and images for render output]

The individual disciplines shall then be broken down as follows, with new sub- folders added as required by additional functionality in the software.

8.2.4.1 Architecture Components

- **Architecture**	
- Casework	
- Ceilings	
- Columns	[Arch non-analytical columns]
- Curtain_Panel_by_Pattern	
- Curtain_Wall_Panels	
- Detail_Components	
- Doors	
- Electrical_Fixtures	[Arch versions]
- Entourage	
- Floors	
- Furniture	
- Generic_Models	
- Lighting_Fixtures	[Arch versions]
- Mass_Elements	
- Mass	
- Planting	
- Plumbing_Fixtures	[Arch versions]
- Profiles	
- Q_Families	
- Roofs	
- Site	
- Speciality_Equipment	
- Stairs_and_Railings	
- Balusters	

- Sustainable_Design
- Walls
- Windows

❖ 8.2.4.2 MEP Components

- **Mechanical Services**
  - Ceilings
  - Ducts
  - Electrical_Components
  - Fire_Protection
  - Generic_Models
  - Mechanical_Components
  - Pipe
  - Plumbing_Components
  - Profiles
  - Speciality_Equipment
  - Sustainable_Design

❖ 8.2.4.3 Structural Components

- **Structure**
  - Boundary_Conditions
  - Columns
  - Connections
  - Floors
  - Foundations
  - Framing
  - Generic_Models
  - Profiles
  - Rebar_Shapes
  - Retaining_Walls
  - Roofs
  - Speciality_Equipment
  - Stiffeners
  - Trusses
  - Walls

❖ 8.2.4.4 Non Discipline-Specific Components

- **General**
  - Annotation [Tags and symbols]
  - Titleblocks [Drawing frame families]

8.3 General Naming Conventions

Use only letters A-Z, hyphen, underscore and numbers 0-9 for all fields.

All fields shall be separated by a hyphen character "-" Do NOT use spaces.

Within a field, either CamelCase or an underscore "_" shall be used instead of a space to separate words.

A single period character "." shall be used to separate the file name from the extension. This character should not be used anywhere else in the file name.

The file extension shall not be amended or deleted.

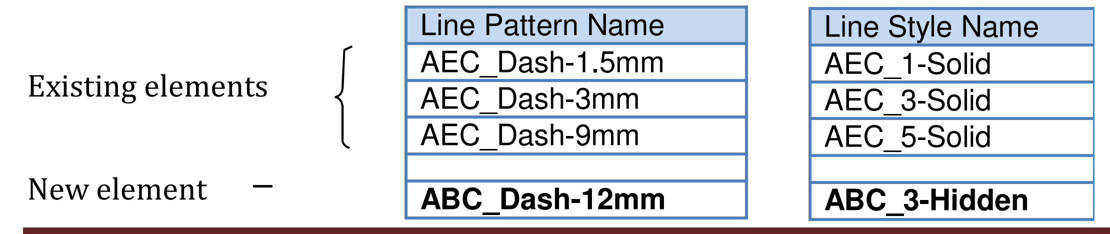
An "XX" shall be used if the file does not refer a single specific zone or level.

The scheme for zone and level sub-division shall be agreed with the other project professionals at the outset and defined in the Project BIM Strategy document.

For 2 digit code examples for discipline, zone and level see Appendix 11.1

Elements where a naming convention is not explicitly defined by this Standard shall adopt the naming convention of existing elements and prefix with a 3- character abbreviation to identify corporate author.

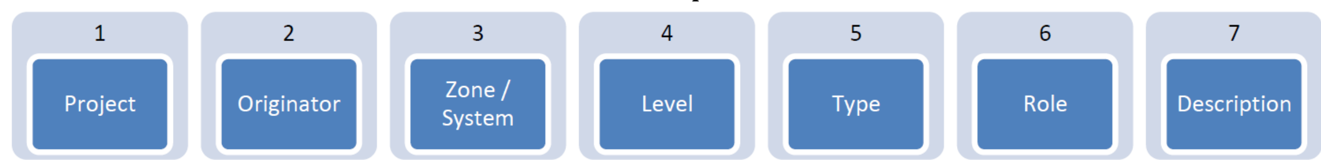
Examples:



	Line Pattern Name	Line Style Name
Existing elements	AEC_Dash-1.5mm	AEC_1-Solid
	AEC_Dash-3mm	AEC_3-Solid
	AEC_Dash-9mm	AEC_5-Solid
New element –	**ABC_Dash-12mm**	**ABC_3-Hidden**

8.4 Model File Naming

Naming of model files shall be based on BS1192:2007. For full compliance, recommended character restrictions should be adopted.



Field 1: **Project** *(Recommended 3 characters)*
An abbreviated code or number identifying the project.

Field 2: **Originator Code** *(Recommended 3 characters)*

An abbreviated code identifying the originating stakeholder.

Field 3: **Zone/System** *(Recommended 2 characters)*

Identifier of which building, area, phase or zone of the project the model file

relates to if the project is sub-divided by zones*).*

Field 4: **Level** *(Recommended 2 characters)*
Identifier of which level, or group of levels, the model file relates to if the project is sub-divided by levels.

Field 5: **Type** *(Recommended 2 characters)*
Document type, which will be **M3** for 3D model files.

Field 6: **Role** *(Recommended 2 characters)*

2 character discipline identifier code. Refer to Appendix 11.1.

Field 7: **Description**

Descriptive field to define the type of data portrayed in the file. Avoid repeating information codified in other fields. Can be used to describe any part of the previous fields, or to further clarify any other aspect of the contained data.
Local / Central *(mandatory when using worksets)*
In workset enabled files, either –LOCAL or –CENTRAL shall be suffixed to the filename.

Examples:

Model File Name	Description
37232-AAA-Z6-01-M3-ST-Main_Model-OCAL.rvt	Job No. 37232, Structural drawing of Zone 6, Level 1 – User local file
FTR-ACM-XX-XX-M3-ST-School_Stage_E.rvt	Acme structures model for School project at Stage E – no zones or segregation of floors
102-ACM-Z1-XX-M3-ME-School.rvt	Acme Building Services model for job 102, Zone 1 all levels

8.5 Workset Naming

Worksets should be named in a consistent and logical manner to aid navigation through the project.

> **Note:**
> As these are created, the „Enabled in All Views" option shall be checked in every case except Furniture. (This cannot be changed later)



Field 1: **Zone** *(Optional)*

Larger projects can be divided horizontal or vertically into zones/levels and so this should be indentified in the workset naming where applicable.

Field 2: **Content**

Description of workset content; used in isolation in smaller projects, or in combination with one or both of Zone and Level on larger projects. Should typically be one of the following:

Ceilings	Ceilings and attached components
Cores	Architectural components of core
Furniture	Furniture and equipment
Interiors	Interior walls and doors
Shell	Exterior walls and openings
Slabs	Horizontal elements including
Circulation	Stairs, ramps and landings
Structure	Structural slabs and columns

Examples:

Workset Name	Example of use
L01-Model	Project broken by levels
L01_14-Internals	Multi-Level Internal layout
East_Lvl26-Partitions	Very large project broken into zones, levels and systems
Core	Small project; core span levels
East-Cores	Large project; cores span levels

8.5.1 Workset Not Defined

Some elements do not require explicit workset definitions due to the standard behaviour of Revit.

- **Grids** These are included in the Shared Levels and Grids.
- **Areas** View specific and don"t require a workset.
- **Annotation** View specific and don"t require a workset.

8.6 Library Object Naming

Field 01	Field 02	Field 03	Field 04	Field 05
Author name	Element/System	Supplier name	Supplier model	Summary info
e.g. *abc*	e.g. *Door*	e.g. *WidgeLtd*	e.g. *Widge1000*	e.g. *Blck-Insul-Blck*

- Fields to be separated with the "_" symbol
- We suggest that Field 02 is the only compulsory field, although National BIM Library objects will have "nbl" for Field 01.
- Data within fields to be separated with the "-" symbol

Field 01

- Optional field to indicate the author of the library object.
- This is chosen as the first field to allow objects from different authors to be grouped when sorted alphabetically.
- No more than six characters will be used.

Field 02

- Compulsory field to indicate the system or element
- The full name or shortened name may be used. Must be camel case for multiple words. For example: *Door*, *Wall* or *AirConUnit*.
- Note that where types of a common parent are used then the parent name may be dropped. So "*Ext*" may be used for "*External Walls*" where Wall is clearly the inherited item.
- The common names used will be provided within supporting documentation.

Field 03

- Optional field to indicate the supplier name for objects representing proprietary items.
- The full name or shortened name may be used. Must be camel case for multiple words. For example: *WidgeLtd*.

Field 04

-

Field 05

- Optional field to indicate the content that is within the object.
- Just enough information should be added here to allow the user to successfully select the library object the user requires.
- Shortened names should be used. For example: *ClyBrck-Insul-Blck* or *Sgl-Pnl-02*
- The common abbreviated names used will be provided within supporting documentation.
- *Further notes*
- Classification will not be included. This information is best placed within the property sets.
- Version information must not be included. This information is best placed within the property sets.
- Field 05 will not attempt to list all of the information within the object as this will lead to conflicting information as the user changes property sets and materials within the context of a project.

Examples

- *nbl_DoorExt_Sgl-Vsn-Pnl-01* for a generic door object
- *nbl_WallExt_Stone-Cavity-Insul-Blck-GypPlstr* for a generic wall object
- *nbl_WallExt_Stone-Cavity-Insul-140Blck-GypPlstr* for a generic wall object where a similar object with 100mm of block is offered.
- *nbl_Chair_WidgeLtd_Widge1000* for a manufacturer chair object

8.7 Parameter Naming

Naming shall adhere to common rules. Parameter names must contain the information necessary for their convenient grouping depending on tasks for which they were defined. Parameter naming rules for specific tasks should be described in the BEP.

Naming of parameters shall be based on the following format:

Field1 Field2…FieldN

where:

Field1 – name describing the object the parameter is applied to (if available) or a description used to group parameters

Field2 – property the parameter is associated to or an additional description used to group parameters

…

FieldN – parameter description

Examples:

Length

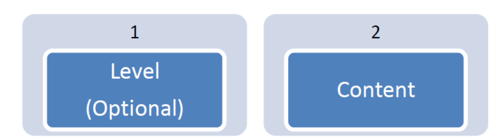
SectionWidth

8.8 View Naming

Conventions in the naming and use of views are necessary to coordinate team activity and prevent inadvertent changes in the output documents.

This standard is limited to droughting views and sheet views (although the Project Browser includes other kinds of elements).

View naming shall be consistent across all references to that view. Renaming of views shall be carried out with care as any changes will be automatically reflected across all documentation.



Field 1: **Level** *(Optional)*

Concise description of the content and purpose of the view

Field 2: **Content**

Where appropriate, further clarification of the location of information shown

Examples:

Name
LEVEL 1 – FLOOR PLAN
LEVEL 1 – CEILING PLAN
LEVEL 3 – DETAIL PLAN AT ELEVATOR 1
NORTH-SOUTH BUILDING SECTION
WALL SECTION 1
SOUTH ELEVATION

The Revit functionality that allows for the **Title on Sheet** to be different to the view name **shall not** be used. Exceptions for structural modelling:

- A view to be used as a substructure or superstructure section. In this instance, the view property "Title on Sheet" shall be renamed to "SECTION".
- A view to be used as a wall or framing elevation. In this instance, the view property "View Name" shall be similar to "VB-2" and the view property "Title on Sheet" shall be renamed similar to "Framing Elevation – VB-2".

Level names are spelled out as they need to appear in a room schedule (as well as how they will appear in sections and elevations.) Do not pad the level number with leading zeros.

Views **shall not** be named in order to make them sort or group more logically in the Project Browser as the grouping and filtering settings take care of that automatically (ie the prefixing of level names by sequential numbers).
View names shall be written in uppercase.
Creation of temporary working views is encouraged. The filtering described in Section 8.10 will ensure these remain in the top „views" section of the project browser.

8.8.1 Special Views

Plan views differ in Revit from other views because they can be duplicated (without reproducing their reference mark as is necessary with elevations and sections.) This results in many special-purpose plans that are temporary or maybe never placed on title-sheets.

The following are exceptions to the view naming conventions described above.

View Type	Naming Convention	Examples
Colour Plans	COLOUR - *<modifier>*	**COLOUR – L1** **COLOUR – LEVEL 1 PRIMARY**
Views created in order to communicate a information relating to elements which meet a specific criteria.		

Export Views	EXPORT - *<modifier>*	**EXPORT – L1** **EXPORT – LEVEL 1 ELECTRICAL BACKGROUND**
Special configurations may be required for supplying graphical information which is specific to a particular discussion. These views shall show information relating to the origin and date/time of the extract as described in Section 7.3.2.		

Import Views	IMPORT - *<modifier>*	**IMPORT – L1** **IMPORT – LEVEL 1 ELECTRICAL**
A dedicated view should be used for attaching linked and imported material that needs to be segregated from other views. (This requirement helps to avoid technical problems and make it easier to control visibility.)		

8.8.2 Callout Views

Detail views, including views which are used only as a container for a linked AutoCAD detail, are named with the same general conventions as other views.

However, where the view refers to a fabrication detail of a common component, it may be pertinent to adopt a naming convention which refers to the Uniclass code associated with that element.

Examples:

Name
A810 Waterproofing System
A820 Exterior Concrete
A910 Interior Partitions
A915 Interior Firestop-Penetration

8.9 View List Scheduling

Two pre-defined schedules are included in the templates to manage the views, namely the **Publication View List** and the **WIP View List**, which contain columns for the following data:

Publication View List				
View Name	Title on Sheet	Scale Value 1:	Sheet Number	Sheet Name

WIP View List		
View Name	Scale Value 1:	Detail Level

Views are grouped by type within both schedules in order to aid navigation. It is recommended that these schedules remain unchanged and that new schedules are created, should the need arise to make this information available externally in a different format.

8.10 Project Browser Organisation

The Project Browser in Revit provides an organisational structure to the views and components within the BIM environment. The following rules are defined within the templates to automatically sort **WIP** views from **Publication** views.

View folders shall be grouped by **Family and Type** and sorted by **Associated Level** in **Ascending** order.

The Views shall be filtered by **Sheet Name** which should be **Equal to** a value of **None**. View section will now show only views not allocated to a drawing sheet.

Sheet folders shall be grouped by **Sheet Number** using **1 Leading Character** and sorted by **Sheet Number** in **Ascending** order. No filters shall be applied to the Sheets.

8.11 Sheet View Naming

Sheet naming shall be based on the Document and Drawing Numbering protocols established for the project. These names automatically match the text as it appears in the titleblock and any schedules.

9 Presentation Styles

9.1 Introduction

This section defines the criteria which ensure the plotted appearance of drawing output from the BIM is consistent and of the highest quality. These criteria are embedded within the associated discipline-specific template files which accompany this document.

Note:
It is not the remit of this standard to dictate aspects covered by existing national draughting standards, and covers only those aspects which are important in delivering
high quality, consistent drawing output from within a Revit BIM environment.

9.2 Templates

Three discipline-specific Revit project templates are available as part of this Standard. They can be obtained from the www.aec-uk.org web site and are maintained by the AEC BIM committee.

Additionally, a number of family templates are included. These templates provide an alternative basis for new families, consistent with the content of this standard.

Where client requirements deviate from those expressed in this standard, project- specific templates shall be created. These shall be stored within the Project BIM Resource standards folder.

9.3 Annotation

Text style shall be **ARIAL NARROW** using font file **ARIALN.TTF**

The appearance of text shall be consistent across a set of drawings.

Annotation shall be legible, clear and concise.

An opaque background should be considered as an aid to clarity.

Text shall remain legible when drawings are plotted at reduced size.

Wherever practical lettering shall not be placed directly on top of lines or symbols.

Dot style arrowheads shall be used instead of closed filled arrowheads when calling up hatched/shaded areas.

Note:
Parametric annotations shall be used wherever possible (e.g. TAGS, KEYNOTES etc.) For example, using the ROOM tools instead of adding text, allows room data to be scheduled to give area plans, finish schedules etc.

9.4 Text Assignment

All text shall be restricted to the following sizes:

Text height (mm) Plotted full size	Line Weight	Usage
1.8	2	General text, dimensions, notes – used on A3 & A4 size drawings
2.5	3	General text, Dimensions notes
3.5	4	Sub-headings,
3.5	5	General text, dimensions, notes – A0 drawings
5.0	7	Normal titles, drawing numbers
7.0	8	Major titles

Alternative text sizes shall not be used without the consent of the BIM Co-ordinator.

9.5 Line Weights

Line weights control the graphical display of on-screen data as well as all published output. Line weights assigned to Model elements are scale dependent whilst those associated with Annotation objects are fixed.

There are 16 model line weights. Each can be given a plotted thickness across the range of drawing scales as defined in appendix 11.8.

Thin Lines mode **shall not** be used as this distorts the production requirements of publication output and promotes over-modelling and over-detailing.

The plotted appearance of modelled components shall be consistent across the project.

Line weights are assigned project-wide by category of component and can be overridden by view and by element. Individual lines on elements can also be overridden. Overriding should be kept to a minimum to aid consistency.

The plotted appearance of modelled components shall be represented in a manner that

provides „depth" to the drawing and allows for adequate differentiation of elements cut in section, profile view and priority elements.

9.6 Line Patterns

The supplied templates contain a number of defined Line Patterns for use in all draughting production work. These Line Patterns are defined in Appendix 0 and any additional Line Patterns shall be created by the BIM Co-ordinator and named according to the naming conventions described in Section 8.3.

9.7 Line Styles

Line Styles are defined in the supplied templates as a project setting. These styles are documented in Appendix 11.7 and any additional Line Styles shall be created
by the BIM Co-ordinator and named according to the naming conventions described in Section 8.3.

9.8 Hatching and Filled Regions

Appendices 11.4 and 0 provide samples of the default Fill Patterns for Model and Draughting usage, which are loaded into the default templates.

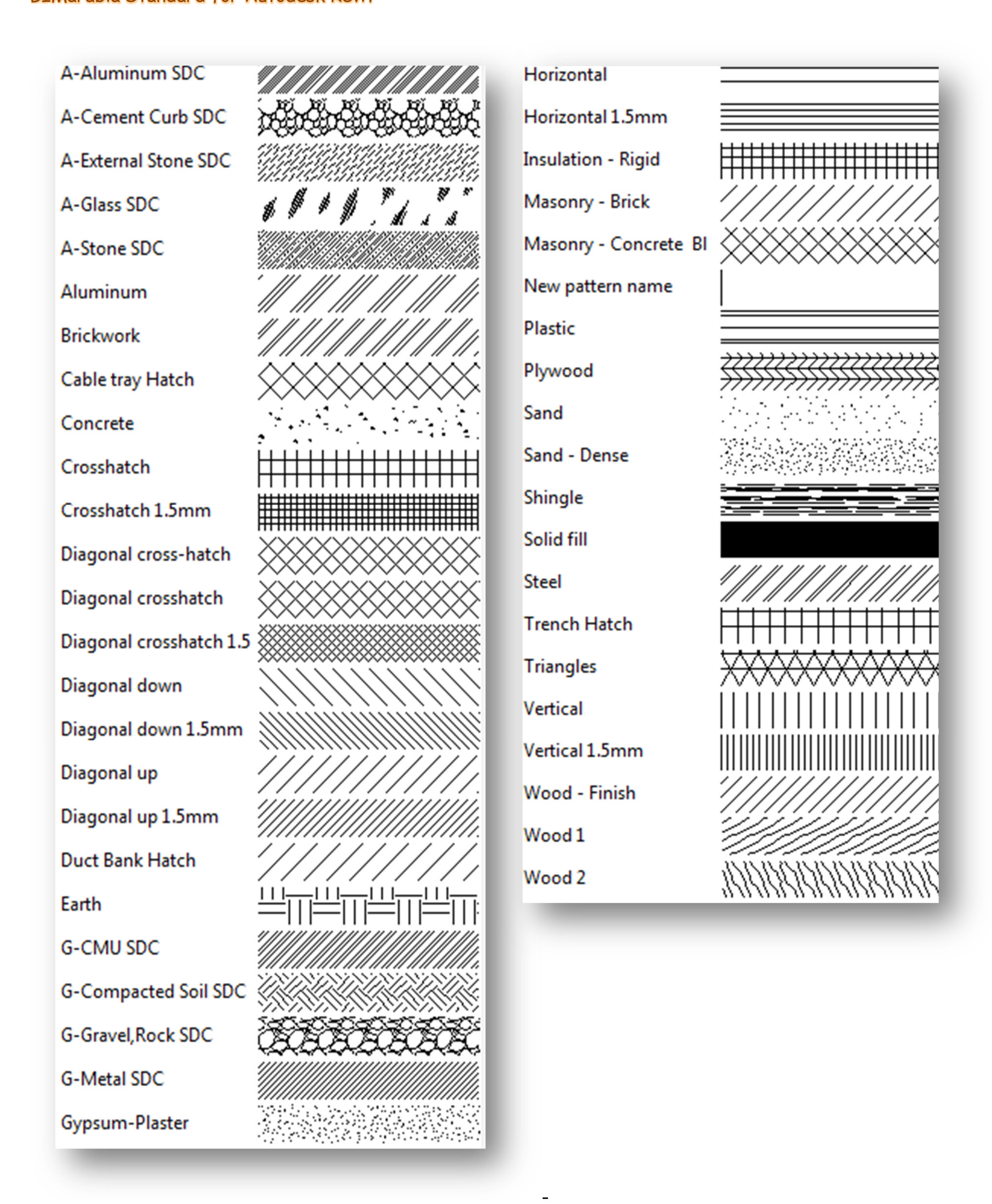
Alternative Fill Patterns shall be used only with the approval of the Project BIM Co-ordinator.

Hatching/patterning shall be created using the relevant tools available within the software.

Where possible, hatch patterns should be assigned to the relevant materials for the elements, rather than assigned as 2D patches.

Care shall be taken to ensure that the draw order and transparency settings of filled regions are appropriate to the situation so as not to cover required graphical information.

The following 'Drafting – Fill Patterns' were used:


A-Aluminum SDC
A-Cement Curb SDC
A-External Stone SDC
A-Glass SDC
A-Stone SDC
Aluminum
Brickwork
Cable tray Hatch
Concrete
Crosshatch
Crosshatch 1.5mm
Diagonal cross-hatch
Diagonal crosshatch
Diagonal crosshatch 1.5
Diagonal down
Diagonal down 1.5mm
Diagonal up
Diagonal up 1.5mm
Duct Bank Hatch
Earth
G-CMU SDC
G-Compacted Soil SDC
G-Gravel,Rock SDC
G-Metal SDC
Gypsum-Plaster
Horizontal
Horizontal 1.5mm
Insulation - Rigid
Masonry - Brick
Masonry - Concrete Bl
New pattern name
Plastic
Plywood
Sand
Sand - Dense
Shingle
Solid fill
Steel
Trench Hatch
Triangles
Vertical
Vertical 1.5mm
Wood - Finish
Wood 1
Wood 2

-

The following 'Model – Fill Patterns' were used:

100mm Horizontal
100mm Squares
100mm horizontal
150 x 150 mm Squares
150mm Horizontal
150mm Squares
200mm Squares
250mm Squares
50mm Horizontal
50mm Squares
50mm horizontal
600 x 1200mm
600 x 600mm
75mm Horizontal
75mm vertical
Block 200x200
Block 200x400
Block 225x225
Block 225x450
Brick - US Standard
Brick 75x225
Brick 80x240 CSR
Brick Soldier Course
Herringbone 100x200
Parquet 152mm
Shake 150mm
Wood Board
Wood Board Wide

9.9 View Templates and Filters

The default templates have a number of pre-defined View Templates and associated View Filters as described in Appendices 11.11 and 11.12.

View Templates shall be used to maintain consistency across published output. Adjustments to the settings of the View Templates shall be carried out only with the agreement of the BIM Co-ordinator.

Adjusted View Templates must be re-applied to all relevant views in order to propagate changes.

9.10 Dimensioning

Default dimension styles exist in the accompanying templates and new styles shall be added only if authorised by the BIM Co-ordinator.

Where practical, all dimensioning shall be created using relevant software dimensioning tools. The dimension text shall not be exploded or overridden, but can be appended to e.g. “1200 (Typ.)”.

Where practical avoid duplicate dimensioning either within a drawing or within a set of drawings.

Where practical, dimension lines shall not be broken and shall not cross other dimension lines.

In general, dimensions shall be placed on a drawing so they may be read from the bottom or right-hand side of the drawing.

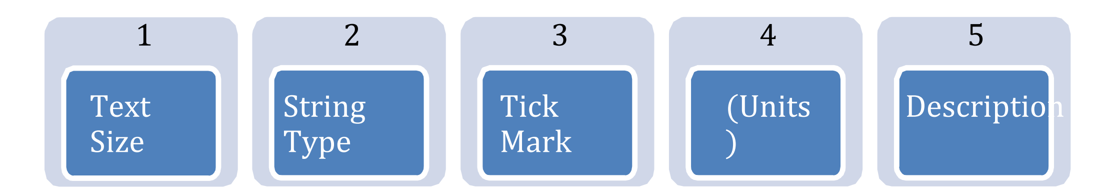
In general, dimension text shall be placed above the dimension line and shall be clear of other lines so that they are legible.

In general, Dimension styles shall adopt standard engineering style dimensioning using closed filled 20° arrow head. *(Deviation: Architects may use diagonal tick style).*

Dimension units shall be predefined within the style, and not left to default to the project units.

Default dimension styles shall not be overridden.

9.10.1 Dimension Style Naming Convention:

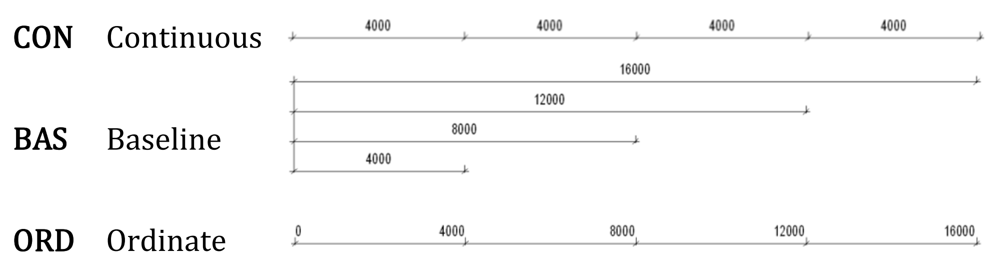


Field 1: **Text Size**

Size of text used on the dimension in the appropriate units. By default this shall be 2.5mm Arial Narrow.

Field 2: **String Type** *(Optional)*

Dimension String Type



Field 3: **Tick Mark**

Description of the tick mark used on the dimension style such as Dot, Arrow or Diagonal tick marks.

Field 4: **(Units)**

The reporting units of the dimension style.

Field 5: **Description** (Optional)

Provision for distinguishing specific dimension styles

Examples:

1.8-Con-Arrow-(mm)
2.5-Con-Diagonal-(mm)-Centreline
2.5-Arrow-(deg)

9.11 Titleblocks

Corporate titleblock are available from the Families area of the central resource folder.

Alternative client-specific versions may also be available from the same location.

Project-specific titleblocks shall be created and stored in the Project Resource folder.

9.12 Symbology

Standard symbols such as north point, section marks and call-ups are available from within the discipline-specific template files and shall be used by default. See Appendix 11.3 for standard drawing navigation symbols.

9.12.1 Section and Detail Marks

Section and Detail marks shall be accessed from within standard template files, Revit‟s default repository or the Central BIM library.
Section and Detail marks used shall be as defined in appendix 11.3. All

Sections shall be numerically labelled.

All **Details** shall be alphabetically labelled.

Where practical, sections shall be listed consecutively, from left to right and from top to bottom on the drawing on which they are drawn.

All sections and details shall be correctly cross-referenced in both directions i.e. cross reference to where the section/detail is actually drawn. Drawing cross referencing shall not include the revision code.

10 Resources

10.1 Introduction

To increase efficiency of BIM working, and to ensure a consistent and high quality output, resources and content shall be shared across the practice.

Certain projects may require deviations from this standard: these shall be defined in the Project BIM Strategy document.

10.2 Software

A consistent software platform will aid the collaboration potential of BIM projects and is recommended. Interoperability between applications should be checked and verified at the outset of the project.

Where 3rd party applications are used, originators shall ensure the standards defined within this document are complied with, unless situations make this impractical.

Any potential implementation of software upgrade during the course of a live project shall be reviewed for its appropriateness by the BIM Co-ordinator who shall raise recommendations for upgrade through the relevant senior manager for approval.

Implementation of any upgrade shall be in line with corporate CAD / BIM software strategy.

10.3 BIM Content / Resource Libraries

Content libraries hold families and other items for use within BIM.

Creation of project-specific content is encouraged but shall be coordinated by the project BIM Manager ensuring content is developed in accordance with this standard and the associated best practice guidelines.

No content shall be stored on users own hard-drives, but shall be shared in a controlled manner through the Project BIM Resource Library to provide access across the project team.

Project content shall be reviewed periodically by the BIM Co-ordinator for inclusion in the Central BIM Resource Library which is read-only.

Revit default family libraries are available through the Central Resource Library as read-only. Any elements from this library which require modification prior to utilisation shall be copied to the Project Resource Library.

BIM Library

- Annotations

The 'Basic Annotation' Tags were developed as part of the 'BIMarabia Standards - Beta Version' development stage. These 'Basic Annotations' were developed in parallel and loaded into the 'Project Template' mentioned above.

- Model Elements

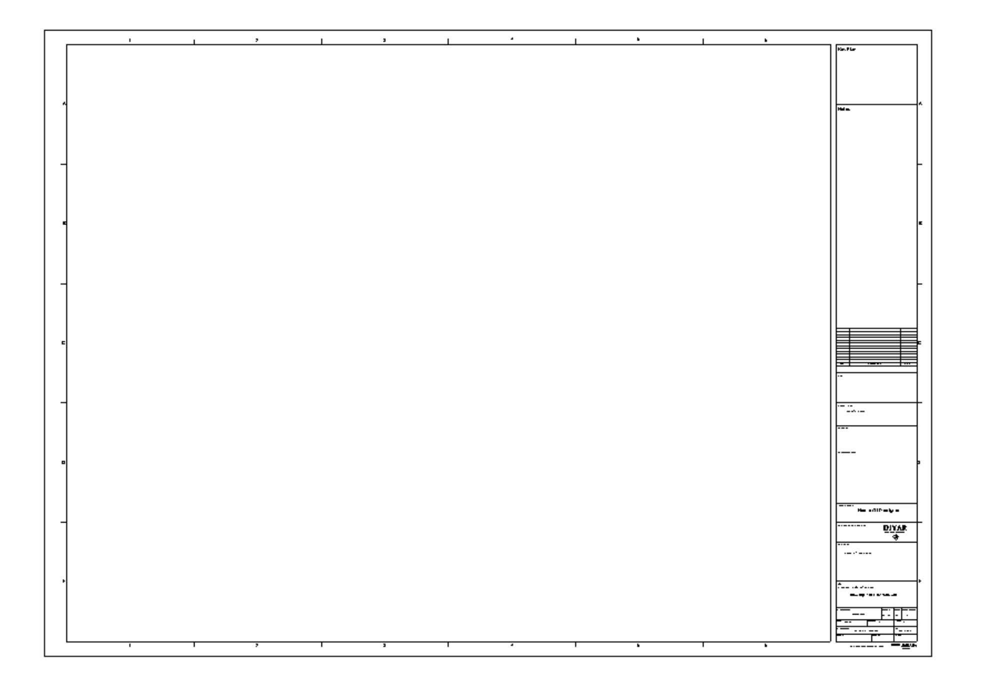
It was agreed that an initial Library of the 'Model Elements' would be developed as part of the 'BIMarabia Standards - Beta Version' development stage. During each upcoming BIM project, further additions to the 'Model Elements' Library will be made considering the guidelines established in the Beta Version.

- Detail Components

Contains the 'Detail Component Families', 'Symbols'. The Basic 'Detail Component Families' and 'Symbols' shall be loaded into the 'Project Template'. Other 'Detail Component Families' and 'Symbols' shall be loaded into the project as needed.

- Title Blocks

The 'Project-A0.rfa' Title Block was developed as a 'Standard - Title Block' of A0 size to be the base for project specific Title Blocks.



<u>'Revision' Schedule:</u>

A 'Revision' Schedule has been embedded to control the 'Revisions' inside the Title Block.

- Typical Details

Contains the 'BIMarabia Standard – 2D Details''. These details need to be converted from 'CAD' format to 'Revit' format and saved as 'Drafting Views'.

It has been agreed that these 'Details' shall not be part of the initial 'Project Templates' but shall be loaded into the 'Revit Project' as per the project requirements.

Hardware

The hardware used for BIM implementation shall meet the requirements imposed by the software developers at least for the next three years. It also shall have a sufficient level of fault tolerance and data security. A server is required for the centralized data storage and processing; a workstation is installed at each user's seat.

The **server** is the main storage place for project data. It shall provide selected user groups as well as individuals (as defined in the information security policy) permanent controlled access to the data. To ensure the reliability and security of the data, it is recommended to develop a solution for backup and archiving.

The **workstation** must ensure reliable operation on the user's workplace. Key parameters affecting the overall performance are processor speed, RAM size, graphic card performance, disk performance, display resolution. Using SSD drives is strongly recommended for modern CAD software. 64-bit hardware and software systems are preferred for professional use.

Using **monitors** with a minimum resolution of 1920x1080 (HD) is recommended at each designer's work seat. Using a dual-monitor system is even better.

You can find the full list of hardware requirements for Autodesk Revit, AutoCAD Civil 3D and Navisworks on the Autodesk website: http://usa.autodesk.com/adsk/servlet/syscert?id=18844534&siteID=123112.

Network resources

Communication between workstations and the server, as well as BIM design collaboration in real time are carried out through the network. The network shall have a sufficient capacity with a suggested data transfer rate of 1 Gbit/s and uninterrupted access to the server.

Disks represent the physical storage media, so they shall have the sufficient access speed, as well as be reliable and fail-safe.

Resource Libraries

Content libraries hold components (families), design templates and family templates for use within BIM. They are put on the file server.

The following rules shall be observed when working on BIM projects:

- Content is developed in accordance with this standard and the associated best practice guidelines.
- Design content shall be reviewed periodically by the BIM Manager for inclusion in the Central BIM Resource Library.

Project BIM Resource Library

This shall be the repository for the storage of project specific standards where deviation from this standard is required due to project or client requirements.

- Standards, templates, title blocks and other data produced in the process of completing the project shall be held within the Project BIM Resource Library
- Additions or modification to content held within this resource shall be carried out in a controlled manner and be at the prior approval.

Central BIM Resource Library

- Standard templates, title blocks, families and other non-project-specific data shall be held within the server based Central BIM Resource Library.
- Additions or modification to content held within this resource shall be carried out in a controlled manner and be at the prior approval.
- Content shall be segregated by software product and version
- When content is updated for use in newer product version:
    - The original data shall be kept and maintained
    - The updated version of the content shall be created in the appropriate location for that product & version. This avoids „forwards incompatibility‟ when using content with the version of the software for which it was originally created

10.3.1 Project BIM Resource Library

This shall be the repository for the storage of project specific standards where deviation from this standard is required due to project or client requirements.

Standards, templates, titleblocks, families and other data produced in the process of completing the project shall be held within the Project BIM Resource Library *(see section 8.2* - Project Folder Structure*)*.

Additions or modification to content held within this resource shall be carried out in a controlled manner and be at the approval of the BIM Co-ordinator.

10.3.2 Central BIM Resource Library

Standard templates, titleblocks, families and other non-project-specific data shall be held within the server based Resource Library, as defined in Section 8.2.1.

Additions or modification to content held within this resource shall be carried out in a controlled manner and be at the approval of the BIM Co-ordinator.

Content shall be segregated by software product and version. When

content is updated for use in newer product version:

- o The original data shall be maintained,
- o The updated version of the content shall be created in the appropriate location for that product & version. This avoids „forwards incompatibility" when using content with the version of the software for which it was originally created.

10.4 Keynotes

A default Keynote file is included as part of this Standard and can be found in the Standards folder within the Central Resources.

This file shall be copied to the project"s Resource>Standards folder for each new project.

Modifications to the project-specific version, are to be managed by the BIM Co- ordinator.

10.5 Shared Parameters

The corporate Shared Parameter file is held in the Standards folder within the central resource. This is maintained by the BIM Management Team (App 11.15)

- When the creation of project-specific families requires the definition of shared parameters, a file shall be created within the project"s resource folder. Once this content is approved for the corporate library, the associated Shared Parameters will be appended to the central Shared Parameters.

Shared parameters can be created and used in loadable families, as well as in the design itself. In the latter case, they can be assigned to any category of Revit elements.

Recommendations on using the Shared Parameter file:

- Revit can simultaneously work with only one Shared Parameter file. In the process of design development you may link several different files one after another, so as to use shared parameters from a number of files.
- As the organization can use several Shared Parameter files, starting a project, make sure you use the correct file.
- It's recommended to establish the corporate Shared Parameter file, in order to ensure the parameter naming consistency during the content creation.
- The corporate Shared Parameter file is held in the Standards folder within the Central BIM resource library along with the respective design template.
- All project participants shall get the Shared Parameter file with a read-only access. Changes in the Shared Parameter file can be only introduced by BIM-manager / coordinator, and all project participants shall be informed. Whenever you add a new shared parameter a backup copy shall be created in prior. If the model is transferred to the contractor, Shared Parameter file goes along with it.
- When the creation of project-specific families requires the definition of shared parameters, a file shall be created within the project's BIM resource folder. Once this content is approved for the corporate library, the associated Shared Parameters will be appended to the central Shared Parameters file.
- It's recommended to group parameters inside the Shared Parameters file (TXT) using the pound sign "#".
- When a new parameter is created, it is recommended to enter a description that would greatly facilitate the further management of the Shared Parameters file.
- Shared Parameters file shall not contain parameters that belong to the Exported Parameters group.
- Groups and parameters shall be named in accordance to the parameter naming rules.
- Group numbering shall be formalized and respected in the Shared Parameters file for all disciplines (applicable if each of them used its own file). E.g. Architecture shall always use number 1, etc.

- Parameter shall be grouped in accordance with Revit categories. If a parameter is shared between several categories it shall fall into the SeveralCategories group.
- Shared Parameters files shall be configured by the BIM Manager/Coordinator.
- The complete list of shared parameters is company-specific.
-
- The following 'Parameters' were defined in the Project Template's 'Shared Parameters' text file and loaded into the Template::

Item	Format	Example
Shared Parameter Files	Same as Project Template or Family	
Shared Parameter Group	Discipline-Category-BIMARABIA_Version	"A-Door-BIMARABIA_01"
Shared Parameter	Description	"Hardware Set"

Notes:

- Items will be listed in their normal order ended with BIMARABIA_01.
- If used in 'Schedules' or 'Annotations', 'Family Name' will appear with 'BIMARABIA_01'.

Name	Category	Type	Group Under	Type/ Instance
ENTERING AIR TEMP. (EWB)	MECHANICAL EQUIPMENT	TEMPERATURE	M-COOLING COIL_00	TYPE
ENTERING WATER TEMP.	MECHANICAL EQUIPMENT	TEMPERATURE	M-COOLING COIL_00	TYPE
LEAVING AIR TEMP. (LDB)	MECHANICAL EQUIPMENT	TEMPERATURE	M-COOLING COIL_00	TYPE
LEAVING AIR TEMP. (LWB)	MECHANICAL EQUIPMENT	TEMPERATURE	M-COOLING COIL_00	TYPE
LEAVING WATER TEMP. (LWT)	MECHANICAL EQUIPMENT	TEMPERATURE	M-COOLING COIL_00	TYPE
MAX. FACE VELOCITY	MECHANICAL EQUIPMENT	VELOCITY	M-COOLING COIL_00	TYPE
MIN. ROWS DEEP	MECHANICAL EQUIPMENT	INTEGER	M-COOLING COIL_00	TYPE
SENSIBLE COOLING CAP.	MECHANICAL EQUIPMENT	COOLING LOAD	M-COOLING COIL_00	TYPE
TOTAL COOLING CAP.	MECHANICAL EQUIPMENT	COOLING LOAD	M-COOLING COIL_00	TYPE
WATER FLOW	MECHANICAL EQUIPMENT	AIR FLOW	M-COOLING COIL_00	TYPE
WATRE SIDE P.D.	MECHANICAL EQUIPMENT	PRESSURE	M-COOLING COIL_00	TYPE
MAX. DBA LEVEL	AIR TERMINAL /MECHANICAL	NUMBER	M-DB LEVEL_00	TYPE
HE COLD SIDE EWT	MECHANICAL EQUIPMENT	TEMPERATURE	MECHANICAL_00	TYPE
HE COLD SIDE LWT	MECHANICAL EQUIPMENT	TEMPERATURE	MECHANICAL_00	TYPE
HE COLD SIDE WATER FLOW	MECHANICAL EQUIPMENT	FLOW	MECHANICAL_00	TYPE
HE COLD SIDE WPD	MECHANICAL EQUIPMENT	PIPE SIZE	MECHANICAL_00	TYPE
HE HOT SIDE EWT	MECHANICAL EQUIPMENT	TEMPERATURE	MECHANICAL_00	TYPE
HE HOT SIDE LWT	MECHANICAL EQUIPMENT	TEMPERATURE	MECHANICAL_00	TYPE
HE HOT SIDE WATER FLOW	MECHANICAL EQUIPMENT	FLOW	MECHANICAL_00	TYPE
HE HOT SIDE WPD	MECHANICAL EQUIPMENT	PIPE SIZE	MECHANICAL_00	TYPE
LOCATION	MECHANICAL EQUIPMENT	TEXT	MECHANICAL_00	INSTANCE
REMARKS	MECHANICAL EQUIPMENT	TEXT	MECHANICAL_00	INSTANCE

Name	Category	Type	Group Under	Type/ Instance
SCHEDULE FILTER	MECHANICAL EQUIPMENT	TEXT	MECHANICAL_00	TYPE
UNIT NO.	MECHANICAL EQUIPMENT	TEXT	MECHANICAL_00	TYPE
UNIT TYPE	MECHANICAL EQUIPMENT	TEXT	MECHANICAL_00	TYPE
VIEW MECHANICAL FILTER	MECHANICAL EQUIPMENT	TEXT	MECHANICAL_00	TYPE
HERTZ	MECHANICAL EQUIPMENT	FREQUENCY	M-ELEC. POWER_00	TYPE
MOTOR SPEED	MECHANICAL EQUIPMENT	VELOCITY	M-ELEC. POWER_00	TYPE
PHASE	MECHANICAL EQUIPMENT	NUMBER OF POLES	M-ELEC. POWER_00	TYPE
POWER	MECHANICAL EQUIPMENT	POWER	M-ELEC. POWER_00	TYPE
VOLTAGE	MECHANICAL EQUIPMENT	ELECTRICAL POTENTIAL	M-ELEC. POWER_00	TYPE
ELECTRICAL HEATER CAP.	MECHANICAL EQUIPMENT	POWER	M-ELECTRICAL HEATER_00	TYPE
ELECTRICAL HEATER HERTZ	MECHANICAL EQUIPMENT	FREQUENCY	M-ELECTRICAL HEATER_00	TYPE
ELECTRICAL HEATER PHASE	MECHANICAL EQUIPMENT	NUMBER OF POLES	M-ELECTRICAL HEATER_00	TYPE
EELECTRICAL HEATER VOLTAGE	MECHANICAL EQUIPMENT	ELECTRICAL POTENTIAL	M-ELECTRICAL HEATER_00	TYPE
EXHAUST FAN AIR FLOW	MECHANICAL EQUIPMENT	FLOW	M-EXHAUST FAN_00	TYPE
EXHAUST FAN EXTERNAL S.P.	MECHANICAL EQUIPMENT	PRESSURE	M-EXHAUST FAN_00	TYPE
EXHAUST FAN HERTZ	MECHANICAL EQUIPMENT	FREQUENCY	M-EXHAUST FAN_00	TYPE
EXHAUST FAN MOTOR SPEED	MECHANICAL EQUIPMENT	VELOCITY	M-EXHAUST FAN_00	TYPE
EXHAUST FAN PHASE	MECHANICAL EQUIPMENT	NUMBER OF POLES	M-EXHAUST FAN_00	TYPE
EXHAUST FAN POWER	MECHANICAL EQUIPMENT	POWER	M-EXHAUST FAN_00	TYPE
EXHAUST FAN TYPE	MECHANICAL EQUIPMENT	TEXT	M-EXHAUST FAN_00	TYPE
EXHAUST FAN VOLTAGE	MECHANICAL EQUIPMENT	ELECTRICAL POTENTIAL	M-EXHAUST FAN_00	TYPE
MAX. SYSTEM TEMP.	MECHANICAL EQUIPMENT	TEMPERATURE	M-EXPANSION TANK_00	TYPE

Name	Category	Type	Group Under	Type/ Instance
SYSTEM SERVED	MECHANICAL EQUIPMENT	TEXT	M-EXPANSION TANK_00	TYPE
TANK PRESSURE RATING	MECHANICAL EQUIPMENT	PRESSURE	M-EXPANSION TANK_00	TYPE
TANK VOLUME	MECHANICAL EQUIPMENT	VOLUME	M-EXPANSION TANK_00	TYPE
AIR FLOW	MECHANICAL EQUIPMENT	AIR FLOW	M-FANS_00	TYPE
EXTERNAL S.P.	MECHANICAL EQUIPMENT	PRESSURE	M-FANS_00	TYPE
MOTOR DRIVE	MECHANICAL EQUIPMENT	TEXT	M-FANS_00	TYPE
FRESH FAN AIR FLOW	MECHANICAL EQUIPMENT	AIR FLOW	M-FRESH FAN_00	TYPE
FRESH FAN EXTERNAL S.P.	MECHANICAL EQUIPMENT	PRESSURE	M-FRESH FAN_00	TYPE
FRESH FAN HERTZ	MECHANICAL EQUIPMENT	FREQUENCY	M-FRESH FAN_00	TYPE
FRESH FAN MOTOR SPEED	MECHANICAL EQUIPMENT	VELOCITY	M-FRESH FAN_00	TYPE
FRESH FAN PHASE	MECHANICAL EQUIPMENT	NUMBER OF POLES	M-FRESH FAN_00	TYPE
FRESH FAN POWER	MECHANICAL EQUIPMENT	POWER	M-FRESH FAN_00	TYPE
FRESH FAN TYPE	MECHANICAL EQUIPMENT	TEXT	M-FRESH FAN_00	TYPE
FRESH FAN VOLTAGE	MECHANICAL EQUIPMENT	ELECTRICAL POTENTIAL	M-FRESH FAN_00	TYPE
FRESH AIR QTY	MECHANICAL EQUIPMENT	AIR FLOW	M-FRESH QTY_00	TYPE
EQUIPMENT SERVED	MECHANICAL EQUIPMENT	TEXT	M-GENERAL_00	INSTANCE
FLOOR / AREASERVED	MECHANICAL EQUIPMENT	TEXT	M-GENERAL_00	INSTANCE
TOTAL HEATING CAP.	MECHANICAL EQUIPMENT	HEATING LOAD	M-HEATING COIL_00	TYPE
TOTAL DYNAMIC HEAD (TDH)	MECHANICAL EQUIPMENT	PRESSURE	M-PUMPS_00	TYPE
WATER FLOW RATE	MECHANICAL EQUIPMENT	AIR FLOW	M-PUMPS_00	TYPE
WATER TEMP.	MECHANICAL EQUIPMENT	TEMPERATURE	M-PUMPS_00	TYPE
RECOVERY UNIT NO.	MECHANICAL EQUIPMENT	TEXT	M-RECOVERY UNIT_00	TYPE

Name	Category	Type	Group Under	Type/ Instance
RECOVERY WHEEL HERTZ	MECHANICAL EQUIPMENT	FREQUENCY	M-RECOVERY UNIT_00	TYPE
RECOVERY WHEEL PHASE	MECHANICAL EQUIPMENT	NUMBER OF POLES	M-RECOVERY UNIT_00	TYPE
RECOVERY WHEEL POWER	MECHANICAL EQUIPMENT	POWER	M-RECOVERY UNIT_00	TYPE
RECOVERY WHEEL VOLTAGE	MECHANICAL EQUIPMENT	ELECTRICAL POTENTIAL	M-RECOVERY UNIT_00	TYPE
WHEEL EFF. EQUAL FRESH AIR FLOW	MECHANICAL EQUIPMENT	INTEGER	M-RECOVERY UNIT_00	TYPE
RETURN FAN AIR FLOW	MECHANICAL EQUIPMENT	AIR FLOW	M-RETURN FAN_00	TYPE
RETURN FAN EXTERNAL S.P.	MECHANICAL EQUIPMENT	PRESSURE	M-RETURN FAN_00	TYPE
RETURN FAN HERTZ	MECHANICAL EQUIPMENT	FREQUENCY	M-RETURN FAN_00	TYPE
RETURNFAN MOTOR SPEED	MECHANICAL EQUIPMENT	VELOCITY	M-RETURN FAN_00	TYPE
RETURN FAN PHASE	MECHANICAL EQUIPMENT	NUMBER OF POLES	M-RETURN FAN_00	TYPE
RETURN FAN POWER	MECHANICAL EQUIPMENT	POWER	M-RETURN FAN_00	TYPE
RETURN FAN TYPE	MECHANICAL EQUIPMENT	TEXT	M-RETURN FAN_00	TYPE
RETURN FAN VOLTAGE	MECHANICAL EQUIPMENT	ELECTRICAL POTENTIAL	M-RETURN FAN_00	TYPE
AIR FLOW RATE	MECHANICAL EQUIPMENT	AIR FLOW	M-SOUND ATTENUATOR_00	TYPE
DUCT HEIGHT	MECHANICAL EQUIPMENT	LENGTH	M-SOUND ATTENUATOR_00	TYPE
DUCT WIDTH	MECHANICAL EQUIPMENT	LENGTH	M-SOUND ATTENUATOR_00	TYPE
S.A. MAX. PRESSURE DEOP	MECHANICAL EQUIPMENT	PRESSURE	M-SOUND ATTENUATOR_00	TYPE
STATIC LOSS (DB) @ 1000 HZ	MECHANICAL EQUIPMENT	INTEGER	M-SOUND ATTENUATOR_00	TYPE
STATIC LOSS (DB) @ 125 HZ	MECHANICAL EQUIPMENT	INTEGER	M-SOUND ATTENUATOR_00	TYPE
STATIC LOSS (DB) @ 2000 HZ	MECHANICAL EQUIPMENT	INTEGER	M-SOUND ATTENUATOR_00	TYPE
STATIC LOSS (DB) @ 250 HZ	MECHANICAL EQUIPMENT	INTEGER	M-SOUND ATTENUATOR_00	TYPE
STATIC LOSS (DB) @ 4000 HZ	MECHANICAL EQUIPMENT	INTEGER	M-SOUND ATTENUATOR_00	TYPE

Name	Category	Type	Group Under	Type/ Instance
STATIC LOSS (DB) @ 500 HZ	MECHANICAL EQUIPMENT	INTEGER	M-SOUND ATTENUATOR_00	TYPE
STATIC LOSS (DB) @ 63 HZ	MECHANICAL EQUIPMENT	INTEGER	M-SOUND ATTENUATOR_00	TYPE
STATIC LOSS (DB) @ 8000 HZ	MECHANICAL EQUIPMENT	INTEGER	M-SOUND ATTENUATOR_00	TYPE
STEAM HUM. AIR FLOW	MECHANICAL EQUIPMENT	AIR FLOW	M-STEAM HUMIDIFIER_00	TYPE
STEAM HUM. CAP.	MECHANICAL EQUIPMENT	NUMBER	M-STEAM HUMIDIFIER_00	TYPE
STEAM HUM. INPUT POWER	MECHANICAL EQUIPMENT	POWER	M-STEAM HUMIDIFIER_00	TYPE
SUPPLY FAN AIR FLOW	MECHANICAL EQUIPMENT	AIR FLOW	M-SUPPLY FAN_00	TYPE
SUPPLY FAN EXTERNAL S.P.	MECHANICAL EQUIPMENT	PRESSURE	M-SUPPLY FAN_00	TYPE
SUPPLY FAN HERTZ	MECHANICAL EQUIPMENT	FREQUENCY	M-SUPPLY FAN_00	TYPE
SUPPLY FAN MOTOR SPEED	MECHANICAL EQUIPMENT	VELOCITY	M-SUPPLY FAN_00	TYPE
SUPPLY FAN PHASE	MECHANICAL EQUIPMENT	NUMBER OF POLES	M-SUPPLY FAN_00	TYPE
SUPPLY FAN POWER	MECHANICAL EQUIPMENT	POWER	M-SUPPLY FAN_00	TYPE
SUPPLY FAN TYPE	MECHANICAL EQUIPMENT	TEXT	M-SUPPLY FAN_00	TYPE
SUPPLY FAN VOLTAGE	MECHANICAL EQUIPMENT	ELECTRICAL POTENTIAL	M-SUPPLY FAN_00	TYPE
MAX. AIR FLOW RATE	MECHANICAL EQUIPMENT	AIR FLOW	M-VAV_00	TYPE
MIN. AIR FLOW RATE	MECHANICAL EQUIPMENT	AIR FLOW	M-VAV_00	TYPE
VAV ELEC. HEATER	MECHANICAL EQUIPMENT	POWER	M-VAV_00	TYPE
VAV INLET SIZE	MECHANICAL EQUIPMENT	LENGTH	M-VAV_00	TYPE
VAV MAX. PRESSURE DROP	MECHANICAL EQUIPMENT	PRESSURE	M-VAV_00	TYPE

- The ‘Shared Parameters’ text file was saved in the same folder location as ‘Template BIMarabia _00.txt’.

10.6 Keyboard Shortcuts

Only approved keyboard shortcuts shall be used (See Appendix 11.13)

BIM Workflow

As the BIM concept in general and Revit as a tool are based on achieving a collaborative and integrated working environment, an adequate workflow for a BIM-based project needs to be developed.

Worksets allow multiple users to simultaneously work on a model file through use of a CENTRAL file and synchronised LOCAL copies. Properly utilised, worksets can significantly improve efficiency and effectiveness on large and multi-user projects.

Appropriate worksets shall be established and elements assigned, either individually or by category, location, task allocation, etc.

To improve hardware performance only the required worksets shall be opened. Revit ensures that elements contained in closed worksets are still updated if changes made in open Worksets impact them during model regeneration.

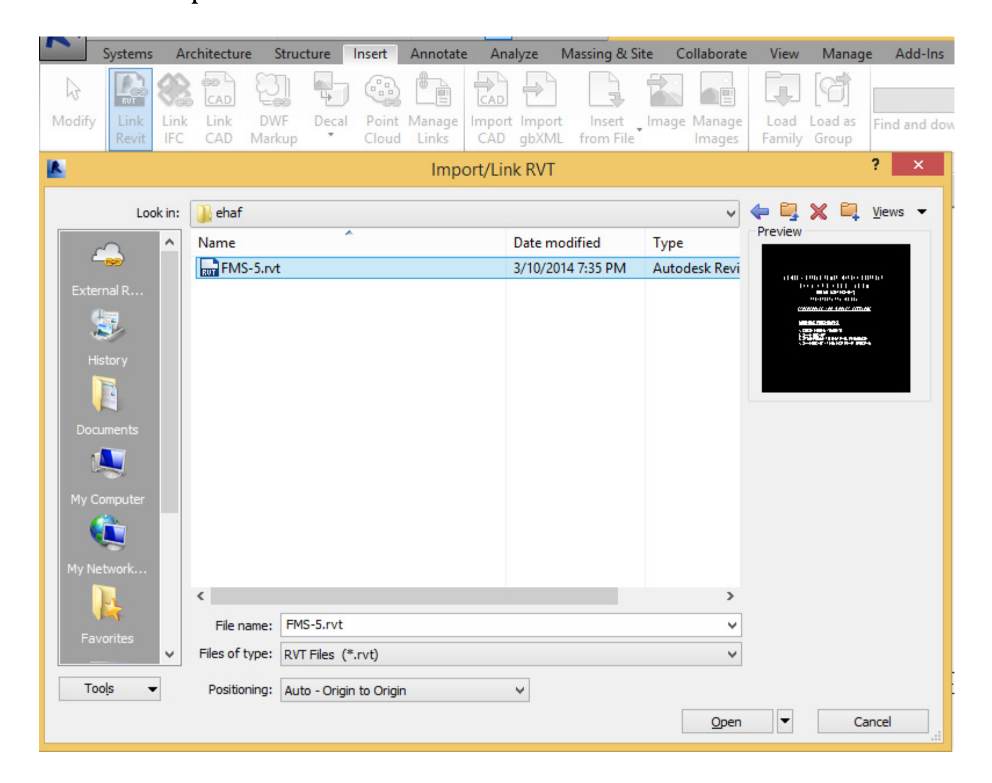
Once worksets are enabled, filenames shall be suffixed with either **–CENTRAL** or **–LOCAL**

- No more than one building shall be modelled in a single file.

In Revit, there are 2 main methods for working collaboratively in a team:

- **<u>Linking:</u>**

  Different Revit models can be linked together as references, resembling the 'X-Ref' concept in the CAD platform.



Advantages:

- Results in smaller files sizes
- Modifications can be more securely managed through 'Windows' file permissions

Disadvantages:

- More fragmented working process than worksharing

- **Worksharing:**

Worksharing allows multiple team members to access to a single shared model (one RVT file) simultaneously through use of a central model.

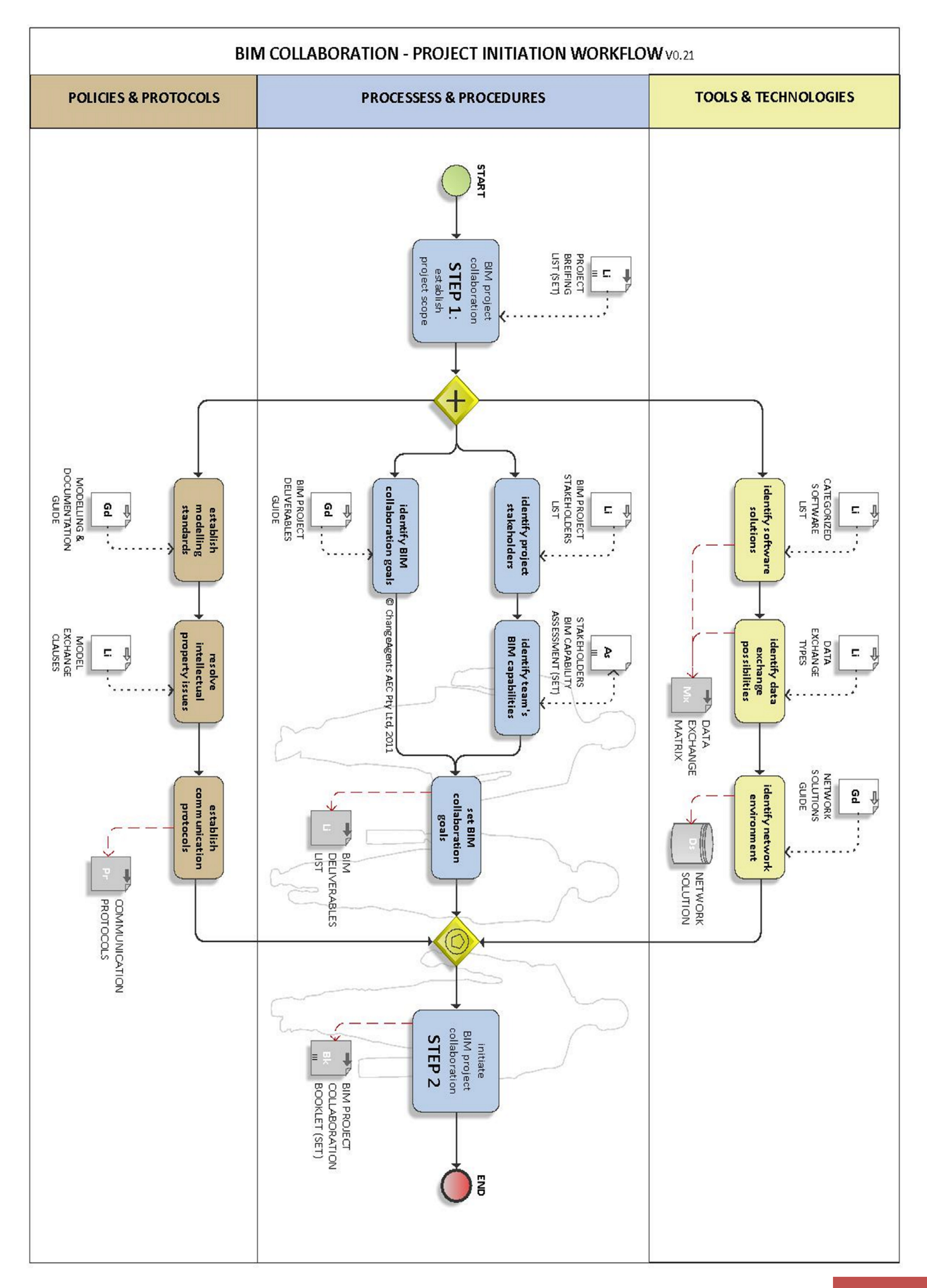
- The Central file shall never be opened, only copied to create local files.
- The Central file should be recreated at regular intervals in order to eliminate redundant data retention.

Advantages:

- More collaborative (BIM concept) allowing real-time project updating

Disadvantages:

- Results in larger file sizes
- Requires very careful management of members' worksets


BIM COLLABORATION - PROJECT INITIATION WORKFLOW V0.21
POLICIES & PROTOCOLS
PROCESSESS & PROCEDURES
TOOLS & TECHNOLOGIES
START
BIM project collaboration STEP 1: establish project scope
PROJECT BREIFING LIST (SET)
identify project stakeholders
BIM PROJECT STAKEHOLDERS LIST
identify team's BIM capabilities
STAKEHOLDERS BIM CAPABILITY ASSESSMENT (SET)
identify BIM collaboration goals
BIM PROJECT DELIVERABLES GUIDE
© ChangeAgents AEC Pty Ltd. 2011
set BIM collaboration goals
BIM DELIVERABLES LIST
establish modelling standards
MODELLING & DOCUMENTATION GUIDE
resolve intellectual property issues
MODEL EXCHANGE CLAUSES
establish communication protocols
COMMUNICATION PROTOCOLS
identify software solutions
CATEGORIZED SOFTWARE LIST
identify data exchange possibilities
DATA EXCHANGE TYPES
DATA EXCHANGE MATRIX
identify network environment
NETWORK SOLUTIONS GUIDE
NETWORK SOLUTION
initiate BIM project collaboration STEP 2
BIM PROJECT COLLABORATION BOOKLET (SET)
END

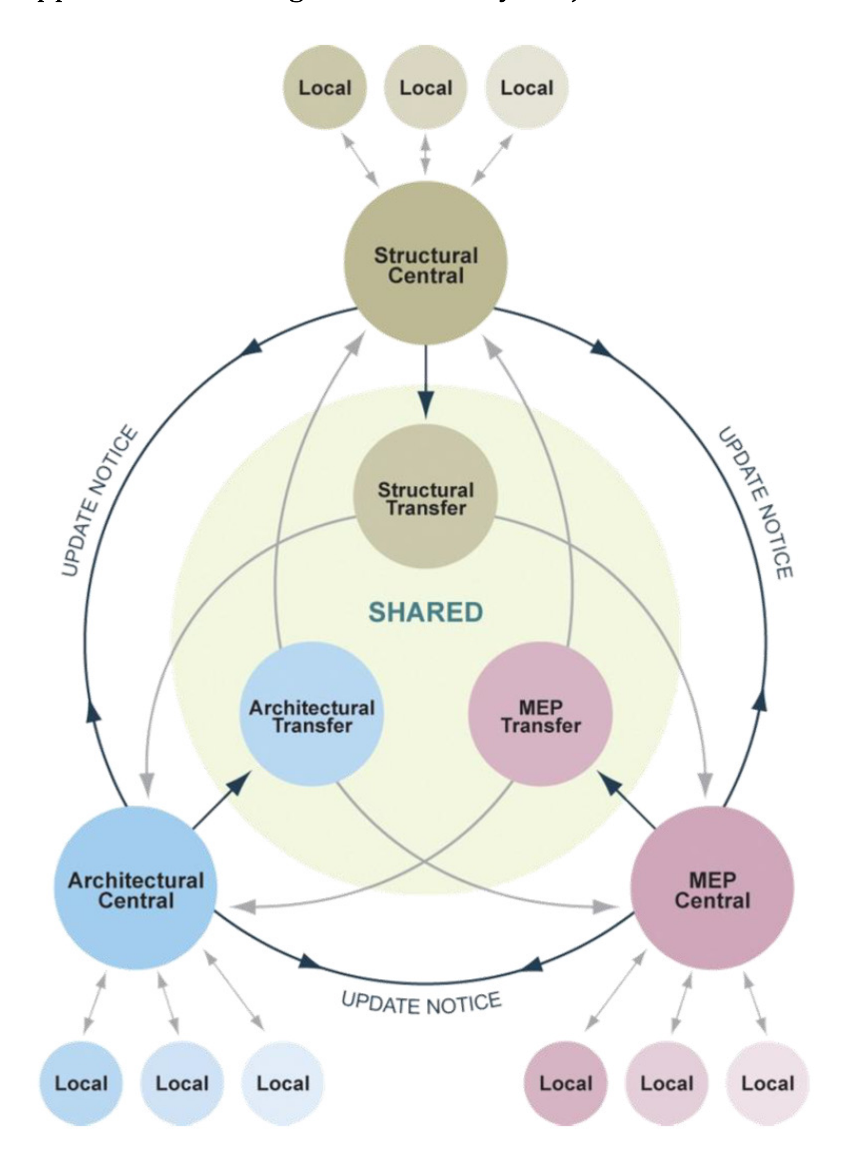
Workflow Scenarios

A typical proposed workflow might include a hybrid solution of both methods. 4 main scenarios have been discussed as follows:

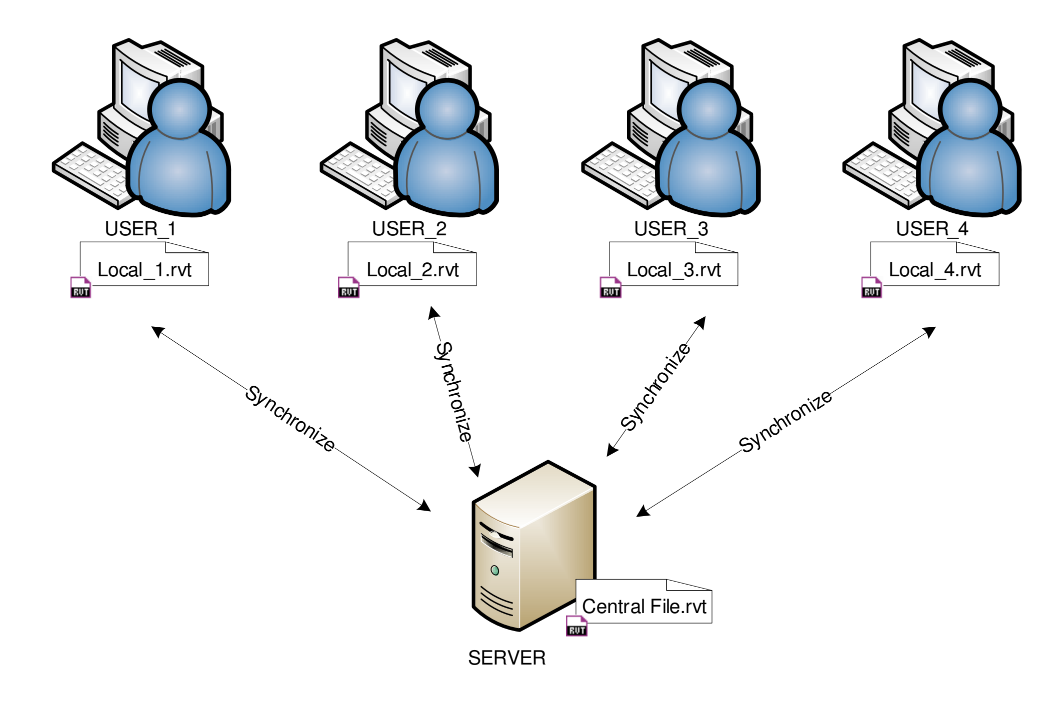
- Worksharing All Disciplines
- Worksharing and Linking Zones
- Worksharing and Linking Disciplines
- Worksharing and Linking Multiple Disciplines

Work sharing All Disciplines

Having all project team members working on a central file using 'Worksharing' is the ideal case to achieve the BIM approach of working collaboratively subject to the hardware capacity.

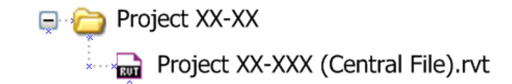


<u>Workflow Diagram</u>



Project Tree

The expected Project Tree associated with that workflow would be:



Application Case

Ideal for relatively small sized projects where performance and size issues can be managed through available hardware.

Worksharing and Linking Zones

In case of large project models exceeding the hardware capacity, the project can be divided into several zones each having a 'Worksharing' Revit model. The different models of the project zones are then combined using 'Linking'.

Workflow Diagram

Worksharing : Zone 3
Arch_User Local_1.rvt
Struc_User Local_2.rvt
MEP_User Local_3.rvt
Zone_3 Central File.rvt
SERVER

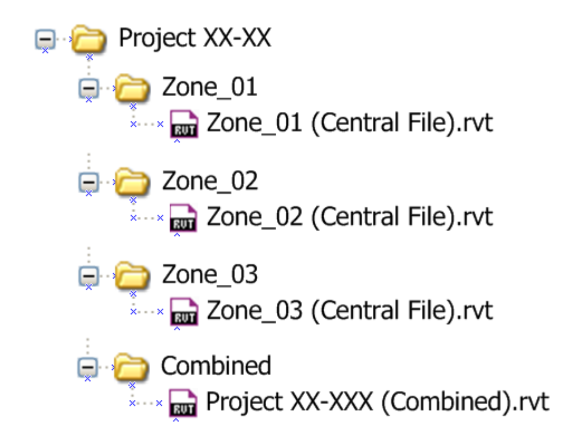
Worksharing : Zone 2
Arch_User Local_1.rvt
Struc_User Local_2.rvt
MEP_User Local_3.rvt
Zone_2 Central File.rvt
SERVER

Worksharing : Zone 1
Arch_User Local_1.rvt
Struc_User Local_2.rvt
MEP_User Local_3.rvt
Zone_1 Central File.rvt
SERVER

Linking
Linking
Linking
Zone 3
Zone 2
Zone 1

Project Tree

The expected Project Tree associated with that workflow would be:



Application Case

Ideal for relatively large sized projects where high collaboration between the different

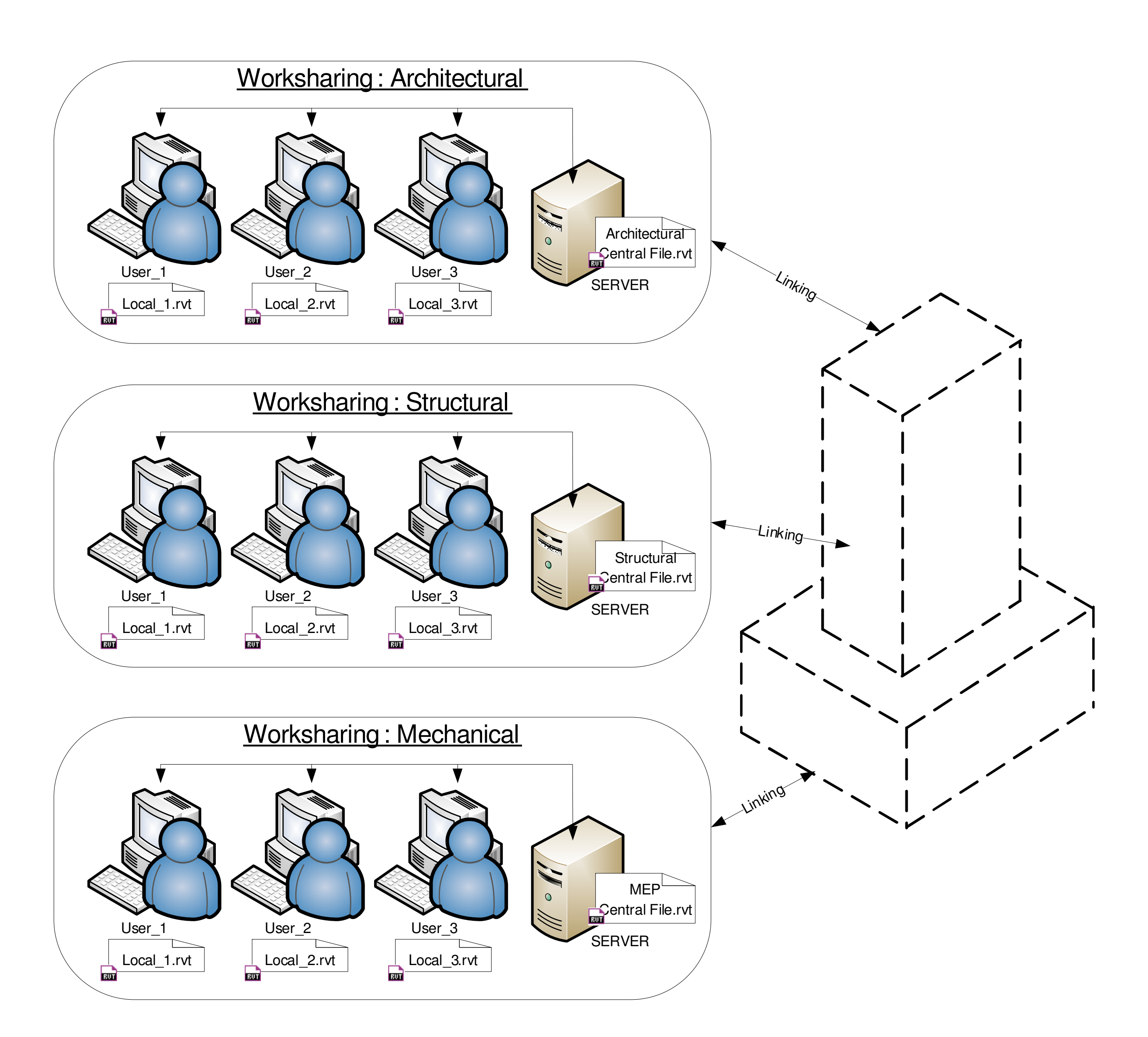
disciplines is needed and performance and size can be an issue.

Worksharing and Linking Disciplines

This method divides the project into several models as per each discipline having a 'Worksharing' Revit model. The different models of the disciplines are then combined using 'Linking'.

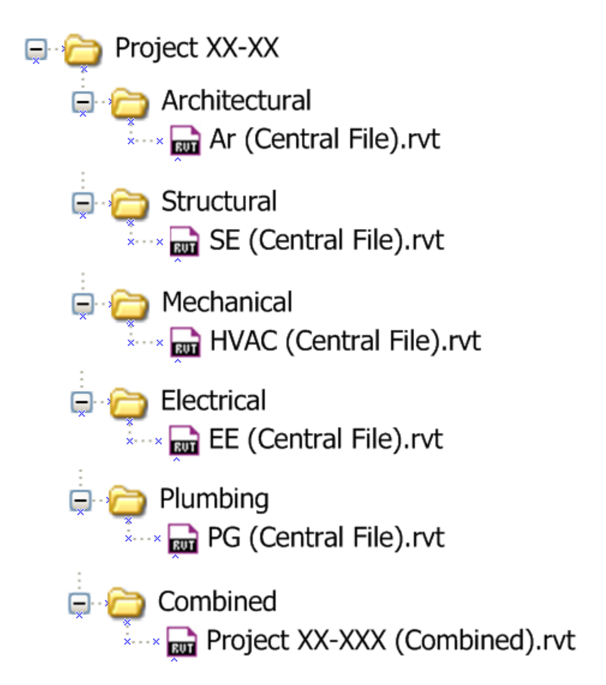
This method is a substitute to the 'Worksharing and Linking Zones' workflow, but offers less collaboration and more strict boundaries between the different disciplines.

Workflow Diagram



Project Tree

The expected Project Tree associated with that workflow would be:



Application Case

Can be applicable for different project sizes where restrictions between the different disciplines are needed.

Worksharing and Linking Multiple Disciplines

This method divides the project into several models where each interacting disciplines have a 'Worksharing' Revit model. The different models of the disciplines are then combined using 'Linking'.

This method is a substitute to the 'Worksharing and Linking Zones' workflow, but offers medium collaboration between the different disciplines.

Workflow Diagram

Worksharing : Architectural , ID

User_1 User_2 User_3

Local_1.rvt Local_2.rvt Local_3.rvt

Arch, ID Central File.rvt

SERVER

Worksharing : Structural

User_1 User_2 User_3

Local_1.rvt Local_2.rvt Local_3.rvt

Structural Central File.rvt

SERVER

Worksharing : MEP

User_1 User_2 User_3

Local_1.rvt Local_2.rvt Local_3.rvt

MEP Central File.rvt

SERVER

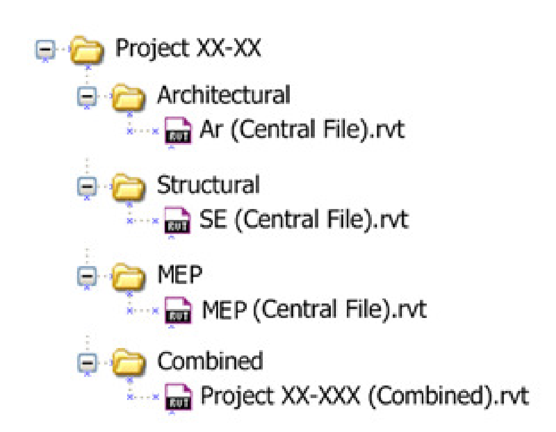
Linking

Linking

Linking

Project Tree

The expected Project Tree associated with that workflow would be:



Application Case Can be applicable for different project sizes where interaction between some disciplines is needed.

11 Appendices

11.1 Model File Naming Codes

Discipline Codes	
AR	Architects
BS	Building surveyors
CI	Civil engineers
DR	Drainage, Road, Sewer
EL	Electrical engineers
CC	Cable Containment
EL	Electrical Services
FA	Fire Alarms
LP	Lightning Protection
LT	Lighting
SE	Security
SP	Small Power
FI	Fire
FM	Facilities managers
GI	GIS, land surveyors
HS	Health and safety
ID	Interior designers
TE	Telecommunications
CL	Client
LA	Landscape architects
ME	Mechanical engineers
CW	Chilled Water
HT	Heating
ME	Mechanical Services
VT	Ventilation
EN	Environmental
PH	Public health
DR	Drainage
FS	Fire Services
PH	Public Health Services
SR	Sanitation and Rainwater
WS	Water Services
QS	Quantity surveyors
RA	Rail
ST	Structural engineers
TP	Town / Transport planners
CO	Contractors
SC	Sub-contractors
SD	Specialist designers
ZZ	General (non-specific)

Project Zone Code Examples	
01	Building or zone 1
ZA	Zone A
B1	Building 1
CP	Car park
A2	Area Designation 2

11.2 Uniclass Table Reference

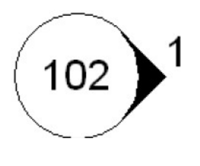
Uniclass Table	Used for
F	Definitions of "spaces"
G	Building objects (normally physical/graphical)
H	Civil engineering objects
J	Detailed classification of non-graphical objects used for
P	Non-specific material definition

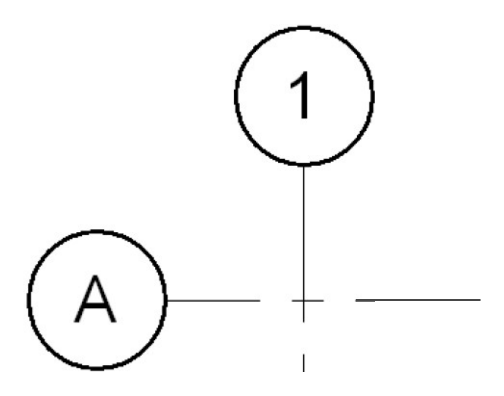
Alternative classification systems to Uniclass, such as CI/FsB have followers within the industry, it is beyond the remit of this standard to suggest which of these is
more or less suitable. CI/FsB is no longer maintained and as such it was discounted from promotion herein.

The full Uniclass tables are available on-line at:

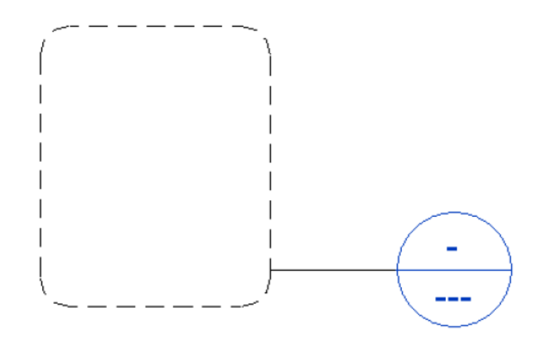
www.cpic.org.uk/en/publications/uniclass-listing.cfm

11.3 Standard Drawing Navigation Symbology









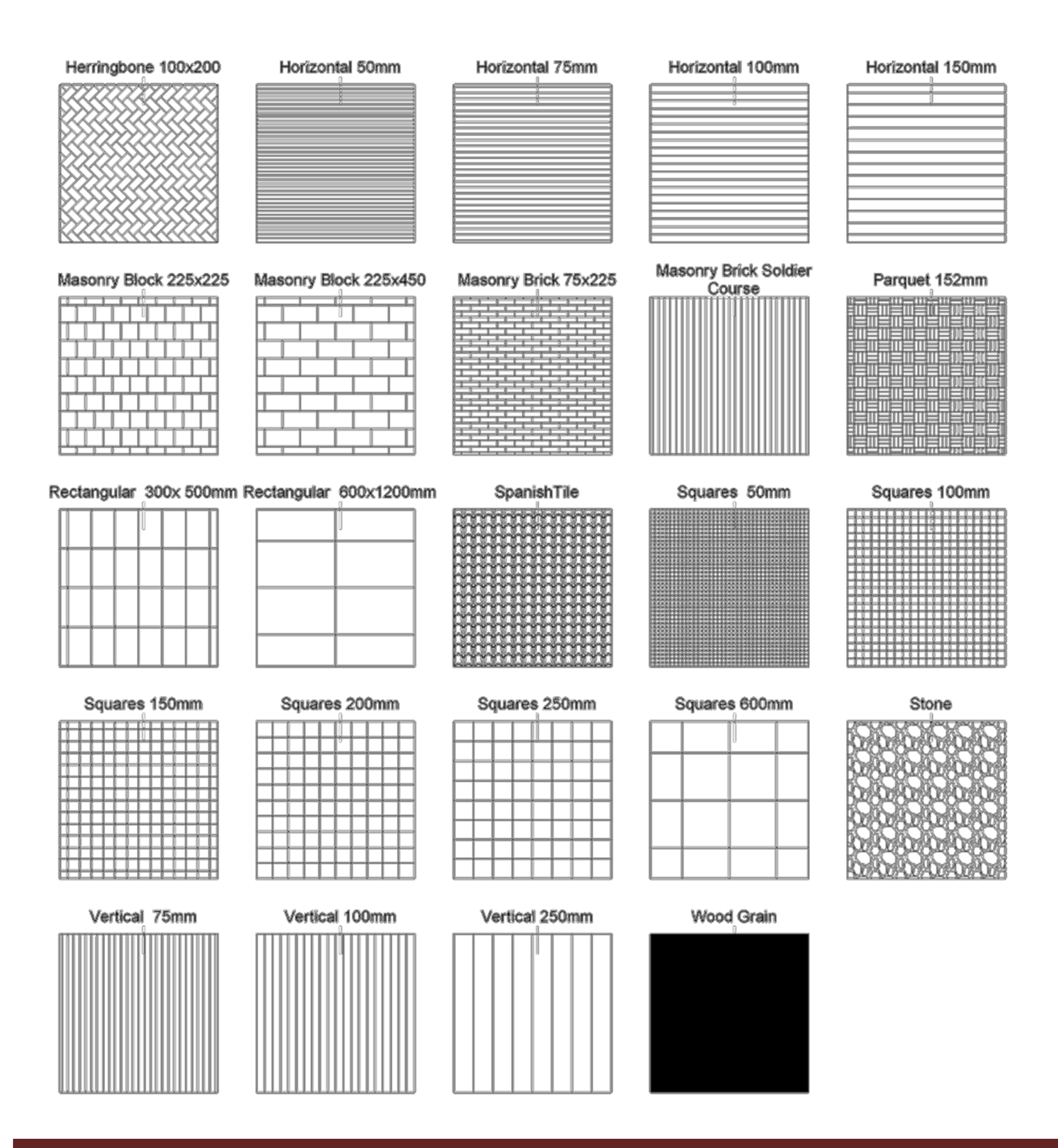
1 **West Elevation**

1 : 100

FFL 4.000 m



11.4 Model Patterns



11.6 Line Patterns

Name	Pattern															
	1		2		3		4		5		6		7		8	
	Type	Value	Type	Value	Type	Value	Type	Value	Type	Value	Type	Value	Type	Value	Type	Value
Demolished	Dash	3	Space	1.5												

Elevation Swing	Dash	2	Space	1												
Grid Line	Dash	12	Space	3	Dash	3	Space	3								
Hidden	Dash	4	Space	2												
Overhead	Dash	2.5	Space	1.5												
Window Swing	Dash	6	Space	3	Dash	3	Space	3								
AEC_Centre	Dash	12	Space	4	Dash	4	Space	4								
AEC_Dash 1.5mm	Dash	1.5	Space	1.5												
AEC_Dash 3mm	Dash	3	Space	3												
AEC_Dash 3mm Loose	Dash	3	Space	6												
AEC_Dash 9mm	Dash	9	Space	4												
AEC_Dash Dot 3mm	Dash	3	Space	2	Dot		Space	2								
AEC_Dash Dot 6mm	Dash	6	Space	4	Dot		Space	4								
AEC_Dash Dot Dot 6mm	Dash	6	Space	4	Dot		Space	4	Dot		Space	4				
AEC_Dot 4mm	Dot		Space	4												
AEC_Dot 1mm	Dot		Space	1												
AEC_Dot 2mm	Dot		Space	2												
AEC_Double Dash	Dash	15	Space	4	Dash	6	Space	4	Dash	6	Space	4				
AEC_Hidden 2mm	Dash	2	Space	1												
AEC_Triple Dash	Dash	15	Space	4	Dash	6	Space	4	Dash	6	Space	4	Dash	6	Space	4

11.7 Line Styles

Category	Line Weight Projection	Line Colour	Line Pattern
Lines	3	RGB 000-161-000	Solid
Area Boundary	12	RGB 128-000-255	Solid
Beyond	3	Black	Solid
Centreline	3	Black	AEC_Centre
Demolished	3	Black	Demolished
Hidden	3	Black	Hidden
Overhead	2	Black	Overhead
Room Separation	12	Cyan	AEC_Dash 3mm
Sketch	6	Magenta	Solid
Space Separation	12	Green	AEC_Dash 3mm
Axis of Rotation	12	Blue	AEC_Centre
Hidden Lines	3	RGB 000-161-000	AEC_Dash 3mm
Insulation Batting Lines	3	Black	Solid
Lines	3	RGB 000-161-000	Solid
Medium Lines	5	Black	Solid
Thin Lines	1	Black	Solid
Wide Lines	10	Black	Solid
General			
AEC_1-Solid	1	Black	Solid
AEC_3-Solid	3	Black	Solid
AEC_5-Solid	5	Black	Solid
AEC_6-Solid	6	Black	Solid
AEC_7-Solid	7	Black	Solid
AEC_8-Solid	8	Black	Solid
AEC_9-Solid	9	Black	Solid
AEC_10-Solid	10	Black	Solid
Architectural			
AEC_10-DPC	10	Magenta	Solid
AEC_10-DPM	10	RGB 000-128-000	AEC_Double Dash
Structural			
AEC_8-RNF_Mesh	8	Black	AEC_Dash Dot 6mm
AEC_11-Rebar	11	Black	Solid

11.8 Line Weights

Pen	1:10	1:20	1:50	1:100	1:200	1:500
1	0.1300	0.1300	0.1300	0.0600	0.0600	0.0600
2	0.1500	0.1500	0.1500	0.1300	0.0600	0.0600
3	0.1800	0.1800	0.1800	0.1500	0.1300	0.0600
4	0.2000	0.2000	0.2000	0.1800	0.1500	0.1300
5	0.2500	0.2200	0.2200	0.2000	0.1800	0.1500
6	0.3500	0.2500	0.2500	0.2200	0.2000	0.1800
7	0.4000	0.3500	0.3500	0.2500	0.2200	0.2000
8	0.5000	0.4000	0.4000	0.3500	0.2500	0.2200
9	0.6000	0.5000	0.5000	0.4000	0.3500	0.2500
10	0.7000	0.6000	0.6000	0.5000	0.4000	0.3500
11	1.0000	0.7000	0.7000	0.6000	0.5000	0.4000
12	1.4000	1.0000	1.0000	0.7000	0.6000	0.5000
13	2.0000	1.4000	1.4000	1.0000	0.7000	0.6000
14	3.0000	2.0000	2.0000	1.4000	1.0000	0.7000
15	4.0000	3.0000	3.0000	2.0000	1.4000	1.0000
16	5.0000	4.0000	4.0000	3.0000	2.0000	1.4000

Perspective
0.0600
0.1300
0.1500
0.1800
0.2000
0.2200
0.2500
0.3500
0.4000
0.5000
0.6000
0.7000
1.0000
1.4000
2.0000
3.0000

Annotation
0.0600
0.1300
0.1500
0.1800
0.2000
0.2200
0.2500
0.3500
0.4000
0.5000
0.6000
0.7000
1.0000
1.4000
2.0000
3.0000

11.8.1 ISO Standard Metric Line Widths

The following line widths are ISO compliant and have been incorporated into the above line weights.

0.13mm
0.18mm
0.25mm
0.35mm
0.50mm
0.70mm
1.00mm
1.40mm
2.00mm

11.9 Object Styles Annotation

Category	Line	Line Colour	Line Pattern
Air Terminal Tags	3	Black	Solid
Area Load Tags	3	Black	Solid
Area Tags	3	Black	Solid
Brace in Plan View	3	Black	Solid
Callout Boundary	3	Black	AEC_Hidden
Callout Leader	3	Black	Solid
Callout Heads	3	Black	Solid
Casework Tags	3	Black	Solid
Ceiling Tags	3	Black	Solid
Communication Device	3	Black	Solid
Connection Symbols	3	Black	Solid
Curtain Panel Tags	3	Black	Solid
Curtain System Tags	3	Black	Solid
Data Device Tags	3	Black	Solid
Detail Item Tags	3	Black	Solid
Door Tags	3	Black	Solid
Duct Accessory Tags	3	Black	Solid
Duct Fitting Tags	3	Black	Solid
Duct Tags	3	Black	Solid
Electrical Circuit Tags	3	Black	Solid
Electrical Equipment	3	Black	Solid
Electrical Fixture Tags	3	Black	Solid
Fire Alarm Device Tags	3	Black	Solid
Flex Duct Tags	3	Black	Solid
Flex Pipe Tags	3	Black	Solid
Floor Tags	3	Black	Solid
Foundation Span Direction	3	Black	Solid
Furniture System Tags	3	Black	Solid
Furniture Tags	3	Black	Solid
Generic Annotations	3	Black	Solid
Centerline	5	Black	AEC_Centre
Generic Model Tags	3	Black	Solid
Grid Heads	10	Black	Solid
Internal Area Load	3	Black	Solid
Internal Line Load Tags	3	Black	Solid
Internal Point Load	3	Black	Solid
Keynote Tags	3	Black	Solid
Level Heads	3	Black	Solid
Lighting Device Tags	3	Black	Solid

CAD Export Settings	
Layer Name	Colour
Left blank awaiting corporate CAD layer standard	

Lighting Fixture Tags	3	Black	Solid
Line Load Tags	3	Black	Solid

Category	Lin e	Line Colour	Line Pattern	CAD Export Settings Layer Name	Colour
Mass Floor Tags	3	Black	Solid		
Mass Tags	3	Black	Solid		
Matchline	5	RGB 128- 128-	AEC_Dash Dot 3mm		
Material Tags	3	Black	Solid		
Mechanical Equipment	3	Black	Solid		
Multi-Category Tags	3	Black	Solid		
Nurse Call Device Tags	3	Black	Solid		
Parking Tags	3	Black	Solid		
Pipe Accessory Tags	3	Black	Solid		
Pipe Fitting Tags	3	Black	Solid		
Pipe Tags	3	Black	Solid		
Plan Region	3	RGB 000- 127-	Hidden		
Planting Tags	3	Black	Solid		
Plumbing Fixture Tags	3	Black	Solid		
Point Load Tags	3	Black	Solid		
Property Line Segment	3	Black	Solid		
Property Tags	3	Black	Solid		
Railing Tags	3	Black	Solid		
Reference Lines	3	RGB 000- 127-	Solid		
Reference Planes	3	RGB 000- 127-	Solid		
Reference Points	3	Black	Solid		
Lines	3	PANTONE Process	Solid		
Planes	3	PANTONE Process	Solid		
Points	6	Black	Solid		
Revision Cloud Tags	3	Black	Solid		
Revision Clouds	3	Black	Solid		
Roof Tags	3	Black	Solid		
Room Tags	3	Black	Solid		
Scope Boxes	3	RGB 000- 127-	Solid		
Section Boxes	3	Black	Solid		
Section Line	3	Black	Solid		
Broken Section	3	Black	AEC_Dot 4mm		
Section Marks	3	Black	Solid		
Medium Lines	6	Black	Solid		
Thin Lines	3	Black	Solid		
Wide Lines	11	Black	Solid		

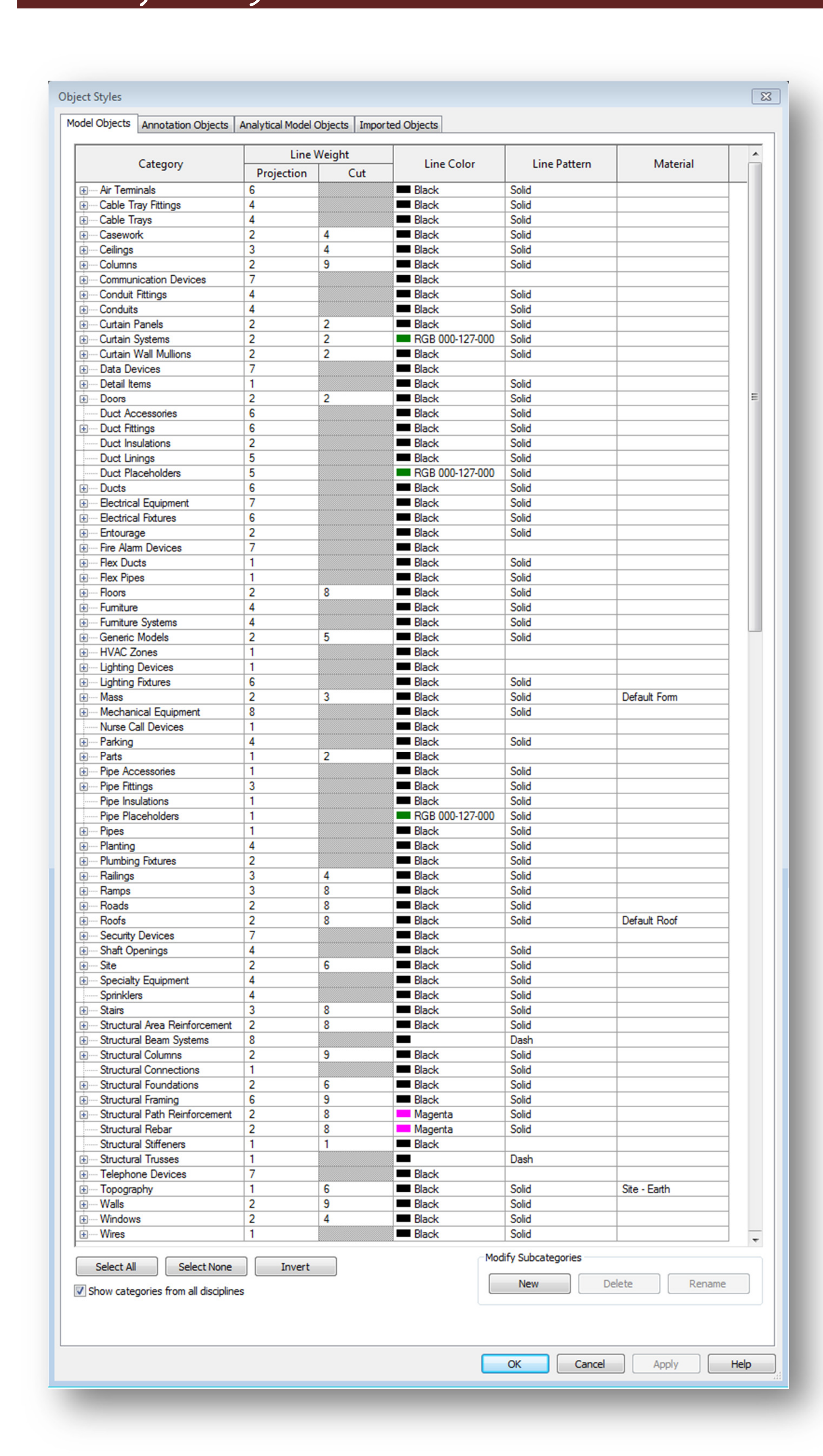
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Category	Line	Line Colour	Line Pattern
Security Device Tags	3	Black	Solid
Site Tags	3	Black	Solid
North Symbol	5	Black	Solid
Space Tags	3	Black	Solid
Span Direction Symbol	3	Black	Solid
Specialty Equipment	3	Black	Solid
Spot Elevation Symbols	3	Black	Solid
Sprinkler Tags	3	Black	Solid
Stair Tags	3	Black	Solid
Structural Annotations	3	Black	Solid
Structural Area Reinforcement	3	Black	Solid
Structural Area Reinforcement	3	Black	Solid
Structural Beam	3	Black	Solid
Structural Column Tags	3	Black	Solid
Structural Connection	3	Black	Solid
Structural Foundation	3	Black	Solid
Structural Framing	3	Black	Solid
Structural Path Reinforcement	3	Black	Solid
Structural Path Reinforcement	3	Black	Solid
Structural Rebar Tags	3	Black	Solid
Structural Stiffener	3	Black	Solid
Structural Truss Tags	3	Black	Solid
Telephone Device Tags	3	Black	Solid
Title Blocks	3	Black	Solid
Medium Lines	6	Black	Solid
Thin Lines	3	Black	Solid
Wide Lines	11	Black	Solid
View Reference	3	Black	Solid
View Titles	3	Black	Solid
Wall Tags	3	Black	Solid
Window Tags	3	Black	Solid
Wire Tag	3	Black	Solid
Zone Tags	3	Black	Solid

CAD Export Settings	
Layer Name	Colour

Left blank awaiting corporate CAD layer standard

11.10 Object Styles - Model



Object Styles

Model Objects | Annotation Objects | Analytical Model Objects | Imported Objects

Category	Line Weight		Line Color	Line Pattern	Material
	Projection	Cut			
Air Terminals	6		Black	Solid	
Cable Tray Fittings	4		Black	Solid	
Cable Trays	4		Black	Solid	
Casework	2	4	Black	Solid	
Ceilings	3	4	Black	Solid	
Columns	2	9	Black	Solid	
Communication Devices	7		Black		
Conduit Fittings	4		Black	Solid	
Conduits	4		Black	Solid	
Curtain Panels	2	2	Black	Solid	
Curtain Systems	2	2	RGB 000-127-000	Solid	
Curtain Wall Mullions	2	2	Black	Solid	
Data Devices	7		Black		
Detail Items	1		Black	Solid	
Doors	2	2	Black	Solid	
Duct Accessories	6		Black	Solid	
Duct Fittings	6		Black	Solid	
Duct Insulations	2		Black	Solid	
Duct Linings	5		Black	Solid	
Duct Placeholders	5		RGB 000-127-000	Solid	
Ducts	6		Black	Solid	
Electrical Equipment	7		Black	Solid	
Electrical Fixtures	6		Black	Solid	
Entourage	2		Black	Solid	
Fire Alarm Devices	7		Black		
Flex Ducts	1		Black	Solid	
Flex Pipes	1		Black	Solid	
Floors	2	8	Black	Solid	
Furniture	4		Black	Solid	
Furniture Systems	4		Black	Solid	
Generic Models	2	5	Black	Solid	
HVAC Zones	1		Black		
Lighting Devices	1		Black		
Lighting Fixtures	6		Black	Solid	
Mass	2	3	Black	Solid	Default Form
Mechanical Equipment	8		Black	Solid	
Nurse Call Devices	1		Black		
Parking	4		Black	Solid	
Parts	1	2	Black		
Pipe Accessories	1		Black	Solid	
Pipe Fittings	3		Black	Solid	
Pipe Insulations	1		Black	Solid	
Pipe Placeholders	1		RGB 000-127-000	Solid	
Pipes	1		Black	Solid	
Planting	4		Black	Solid	
Plumbing Fixtures	2		Black	Solid	
Railings	3	4	Black	Solid	
Ramps	3	8	Black	Solid	
Roads	2	8	Black	Solid	
Roofs	2	8	Black	Solid	Default Roof
Security Devices	7		Black		
Shaft Openings	4		Black	Solid	
Site	2	6	Black	Solid	
Specialty Equipment	4		Black	Solid	
Sprinklers	4		Black	Solid	
Stairs	3	8	Black	Solid	
Structural Area Reinforcement	2	8	Black	Solid	
Structural Beam Systems	8			Dash	
Structural Columns	2	9	Black	Solid	
Structural Connections	1		Black	Solid	
Structural Foundations	2	6	Black	Solid	
Structural Framing	6	9	Black	Solid	
Structural Path Reinforcement	2	8	Magenta	Solid	
Structural Rebar	2	8	Magenta	Solid	
Structural Stiffeners	1	1	Black		
Structural Trusses	1			Dash	
Telephone Devices	7		Black		
Topography	1	6	Black	Solid	Site - Earth
Walls	2	9	Black	Solid	
Windows	2	4	Black	Solid	
Wires	1		Black	Solid	

Select All | Select None | Invert

☑ Show categories from all disciplines

Modify Subcategories: New | Delete | Rename

OK | Cancel | Apply | Help

Object Styles

Model Objects | Annotation Objects | Analytical Model Objects | Imported Objects

Category	Line Weight	Line Color	Line Pattern
	Projection		
Adaptive Points	1	Black	Solid
Air Terminal Tags	6	Black	Solid
Analytical Beam Tags	5	RGB 247-150-070	Solid
Analytical Brace Tags	5	RGB 210-210-000	Solid
Analytical Column Tags	5	RGB 083-141-213	Solid
Analytical Floor Tags	5	RGB 128-064-000	Solid
Analytical Isolated Foundation Tags	7	RGB 165-165-165	Solid
Analytical Slab Foundation Tags	5	RGB 155-187-089	Solid
Analytical Wall Foundation Tags	5	RGB 079-098-040	Solid
Analytical Wall Tags	5	RGB 000-200-200	Solid
Area Load Tags	1	Black	
Area Tags	4	Black	Solid
Assembly Tags	1	Black	
Brace in Plan View Symbols	3	Black	Hidden
Cable Tray Fitting Tags	1	Black	Solid
Cable Tray Tags	1	Black	Solid
Callout Boundary	3	Black	Double dash
Callout Heads	1	Black	Solid
Casework Tags	4	Black	Solid
Ceiling Tags	4	Black	Solid
Communication Device Tags	1	Black	
Concrete Cover References	2	RGB 000-127-000	Rebar Cover Lines
Conduit Fitting Tags	1	Black	Solid
Conduit Tags	1	Black	Solid
Connection Symbols	4	Black	Solid
Curtain Panel Tags	4	Black	Solid
Curtain System Tags	4	Black	Solid
Data Device Tags	1	Black	
Detail Item Tags	4	Black	Solid
Door Tags	2	Black	Solid
Duct Accessory Tags	6	Black	Solid
Duct Fitting Tags	6	Black	Solid
Duct Insulation Tags	6	Black	Solid
Duct Lining Tags	6	Black	Solid
Duct Tags	6	Black	Solid
Electrical Equipment Tags	2	Black	Solid
Electrical Fixture Tags	2	Black	Solid
Elevation Marks	2	Black	
Fire Alarm Device Tags	1	Black	
Flex Duct Tags	1	Black	Solid
Flex Pipe Tags	1	Black	Solid
Floor Tags	2	Black	Solid
Foundation Span Direction Symbol	1	Black	Solid
Furniture System Tags	2	Black	Solid
Furniture Tags	1	Black	Solid
Generic Annotations	1	Black	Solid
Generic Model Tags	3	Black	Solid
Grid Heads	3	Black	Solid
Guide Grid	1	PANTONE Process	Solid
Internal Area Load Tags	1	Black	
Internal Line Load Tags	1	Black	
Internal Point Load Tags	1	Black	
Keynote Tags	4	Black	Solid
Level Heads	2	Black	Solid
Lighting Device Tags	1	Black	
Lighting Fixture Tags	4	Black	Solid
Line Load Tags	1	Black	
Mass Floor Tags	4	Black	
Mass Tags	4	Black	Solid
Matchline	8	Black	Centre

Category	Line Weight	Line Color	Line Pattern
Matchline	8	Black	Centre
Material Tags	3	Black	Solid
Mechanical Equipment Tags	6	Black	Solid
Multi-Category Tags	2	Black	Solid
Nurse Call Device Tags	1	Black	
Parking Tags	2	Black	Solid
Part Tags	6	Black	
Pipe Accessory Tags	6	Black	Solid
Pipe Fitting Tags	6	Black	Solid
Pipe Insulation Tags	6	Black	Solid
Pipe Tags	6	Black	Solid
Plan Region	1	RGB 000-127-000	Dash
Planting Tags	2	Black	Solid
Plumbing Fixture Tags	3	Black	Solid
Point Load Tags	1	Black	
Property Line Segment Tags	3	Black	Solid
Property Tags	3	Black	Solid
Railing Tags	3	Black	
Reference Lines	1	RGB 000-127-000	Solid
Reference Planes	1	RGB 000-127-000	Aligning Line
Reference Points	1	RGB 118-050-133	Solid
Revision Cloud Tags	6	Black	Solid
Revision Clouds	7	Black	Solid
Roof Tags	4	Black	Solid
Room Tags	4	Black	Solid
Section Boxes	1	Black	
Section Line	2	Black	Double dash
Section Marks	4	Black	Solid
Security Device Tags	1	Black	
Site Tags	4	Black	Solid
Space Tags	1	Black	
Span Direction Symbol	1	Black	Solid
Specialty Equipment Tags	4	Black	Solid
Spot Elevation Symbols	4	Black	Solid
Sprinkler Tags	1	Black	Solid
Stair Tags	3	Black	Solid
Structural Annotations	3	Black	Solid
Structural Area Reinforcement Sym...	3	Black	Solid
Structural Area Reinforcement Tags	6	Black	
Structural Beam System Tags	6	Black	Solid
Structural Column Tags	6	Black	Solid
Structural Connection Tags	1	Black	Solid
Structural Foundation Tags	6	Black	Solid
Structural Framing Tags	4	Black	Solid
Structural Path Reinforcement Sym...	3	Black	Solid
Structural Path Reinforcement Tags	6	Black	
Structural Rebar Tags	6	Black	Solid
Structural Stiffener Tags	6	Black	
Structural Truss Tags	6	Black	
Telephone Device Tags	1	Black	
Title Blocks	1	Black	Solid
View Reference	1	Black	
View Titles	1	Black	Solid
Wall Tags	1	Black	Solid
Window Tags	1	Black	Solid
Wire Tag	1	Black	Solid
Zone Tags	1	Black	

Select All | Select None | Invert

Modify Subcategori

New

☑ Show categories from all disciplines

OK

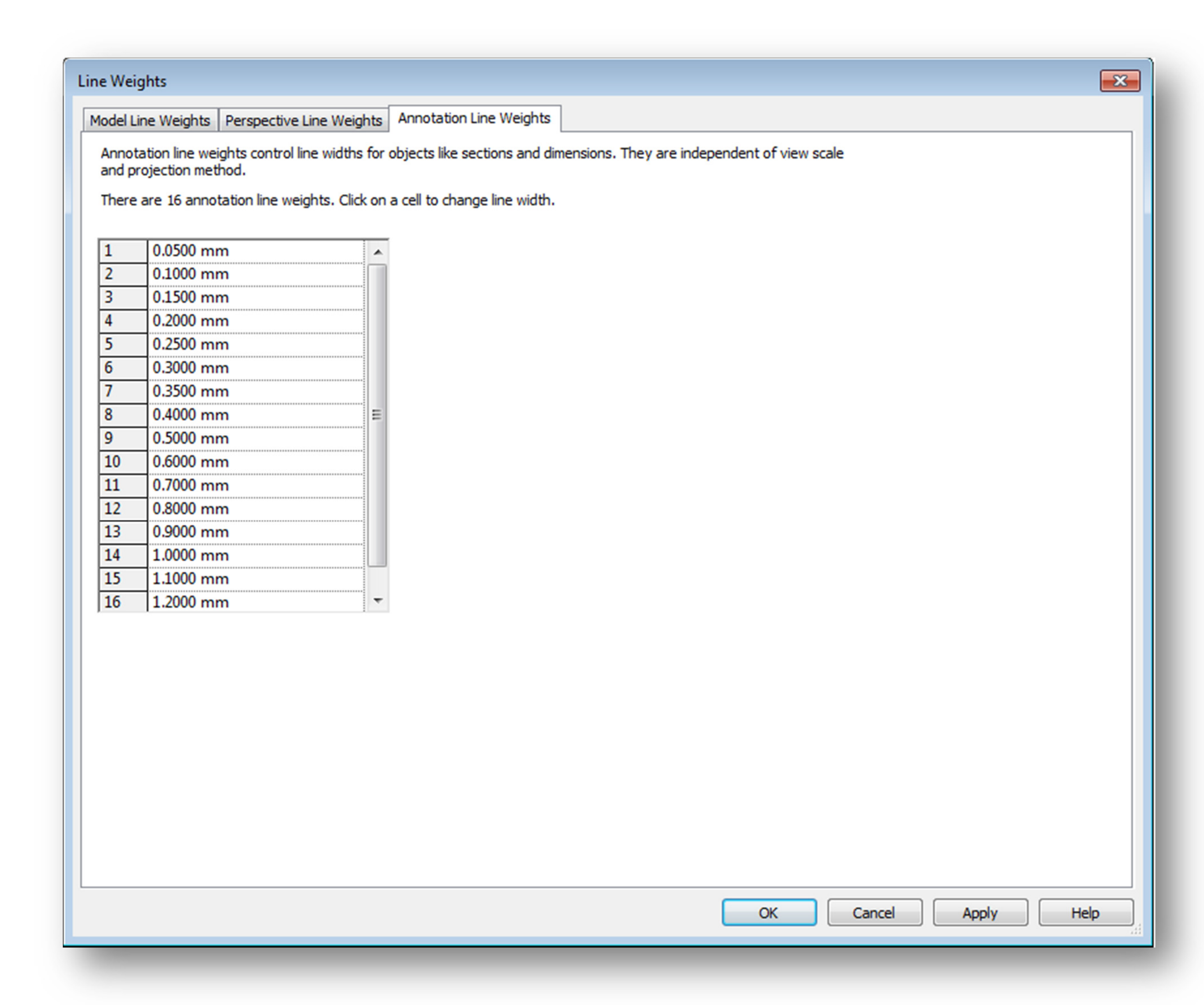
Line Styles, Line Weights, Line Patterns:

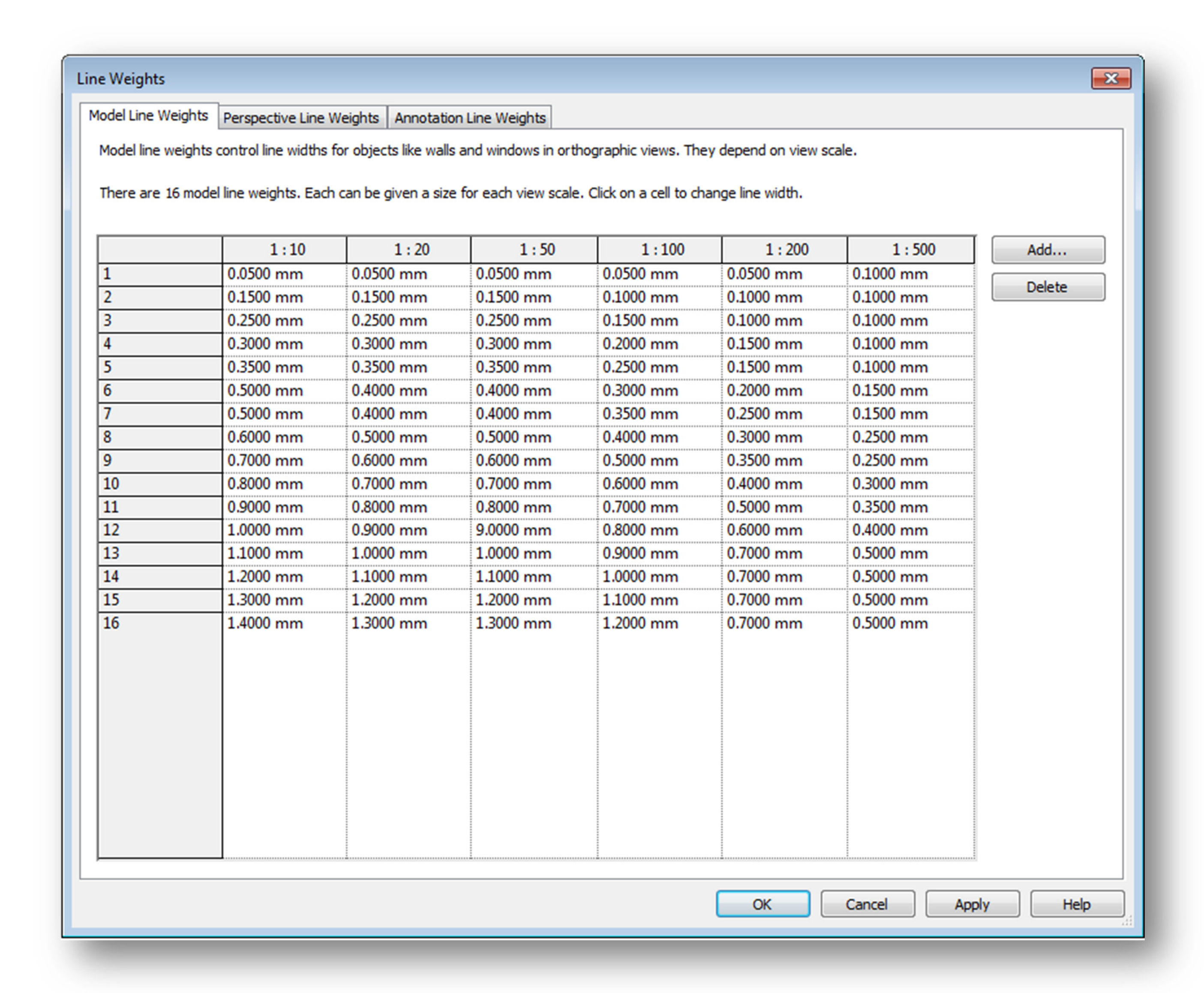
The following 'Line Styles' were used:

Line Styles

Category	Line Weight Projection	Line Color	Line Pattern
Lines	1	RGB 000-166-000	Solid
<Area Boundary>	6	RGB 128-000-255	Solid
<Beyond>	1	Black	Solid
<Centerline>	1	Black	Center
<Demolished>	1	Black	Demolished
<Hidden>	1	Black	Hidden
<Overhead>	1	Black	Overhead
<Room Separation>	1	Black	Dash
<Sketch>	3	RGB 225-000-255	Solid
<Space Separation>	1	Black	
A-Wide-1Hour Fire SDC_1	10	Blue	1Hour Fire SDC
A-Wide-1Hour Fire(Smok...	8	Blue	1Hour Fire SDC
A-Wide-2Hour Fire SDC_1	10	RGB 255-128-000	2Hour Fire SDC
A-Wide-2Hour Fire(Smok...	8	RGB 255-128-000	2Hour Fire SDC
A-Wide-3Hour Fire SDC_1	10	Red	3Hour Fire SDC
A-Wide-Moisture Barriers ...	8	Black	Mositure Barriers
Axis of Rotation	6	Blue	Center
E-GRND-CIRC	3	Cyan	Solid
E-LITE-CIRC-SLAB	3	Cyan	Solid
E-LITE-EMER-CIRC-SLAB	3	RGB 204-204-000	Solid
E-LITE-LSAF-CIRC-SLAB	3	RGB 153-204-000	Solid
E-LTNG-CIRC	3	Cyan	Solid
E-POWR-CIRC-FLOR	3	Cyan	Dash
E-POWR-EMER-CIRC-F...	3	RGB 204-204-000	Dash
E-POWR-LSAF-CIRC-FL...	3	RGB 153-204-000	Dash
Hidden Lines	1	RGB 000-166-000	Dash
Insulation Batting Lines	1	Black	Solid
Lines	1	RGB 000-166-000	Solid
Medium Lines	3	Black	Solid
S-Bottom RFT	9	Magenta	Solid
S-CONCRETE SECTIONS	6	Black	Solid
S-Section RFT	1	Magenta	Solid
S-Top RFT	9	Magenta	SDC-HIDDEN_1
T-ACCS-Wire	3	Green	Solid
T-AuVG-Wire	3	Green	Solid
T-CCTV-Wire	3	Green	Solid
T-Data-Wire	3	Green	Solid
T-Fire-DC	3	Magenta	Dash
T-Fire-Loop	3	Green	Solid
T-MATV-Wire	3	Green	Solid
T-Phone-Wire	3	Yellow	Dash
T-PPAD-Wire	3	Yellow	Solid
Thin Lines	1	Black	Solid
Wide Lines	5	Black	Solid

The following 'Line Weights' were used:





Line Weights

Model Line Weights | Perspective Line Weights | Annotation Line Weights

Model line weights control line widths for objects like walls and windows in orthographic views. They depend on view scale.

There are 16 model line weights. Each can be given a size for each view scale. Click on a cell to change line width.

	1 : 10	1 : 20	1 : 50	1 : 100	1 : 200	1 : 500
1	0.0500 mm	0.0500 mm	0.0500 mm	0.0500 mm	0.0500 mm	0.1000 mm
2	0.1500 mm	0.1500 mm	0.1500 mm	0.1000 mm	0.1000 mm	0.1000 mm
3	0.2500 mm	0.2500 mm	0.2500 mm	0.1500 mm	0.1000 mm	0.1000 mm
4	0.3000 mm	0.3000 mm	0.3000 mm	0.2000 mm	0.1500 mm	0.1000 mm
5	0.3500 mm	0.3500 mm	0.3500 mm	0.2500 mm	0.1500 mm	0.1000 mm
6	0.5000 mm	0.4000 mm	0.4000 mm	0.3000 mm	0.2000 mm	0.1500 mm
7	0.5000 mm	0.4000 mm	0.4000 mm	0.3500 mm	0.2500 mm	0.1500 mm
8	0.6000 mm	0.5000 mm	0.5000 mm	0.4000 mm	0.3000 mm	0.2500 mm
9	0.7000 mm	0.6000 mm	0.6000 mm	0.5000 mm	0.3500 mm	0.2500 mm
10	0.8000 mm	0.7000 mm	0.7000 mm	0.6000 mm	0.4000 mm	0.3000 mm
11	0.9000 mm	0.8000 mm	0.8000 mm	0.7000 mm	0.5000 mm	0.3500 mm
12	1.0000 mm	0.9000 mm	9.0000 mm	0.8000 mm	0.6000 mm	0.4000 mm
13	1.1000 mm	1.0000 mm	1.0000 mm	0.9000 mm	0.7000 mm	0.5000 mm
14	1.2000 mm	1.1000 mm	1.1000 mm	1.0000 mm	0.7000 mm	0.5000 mm
15	1.3000 mm	1.2000 mm	1.2000 mm	1.1000 mm	0.7000 mm	0.5000 mm
16	1.4000 mm	1.3000 mm	1.3000 mm	1.2000 mm	0.7000 mm	0.5000 mm

Add... | Delete

OK | Cancel | Apply | Help

The following 'Line Patterns' were used:

Name:	Line Pattern
1Hour Fire SDC	
2Hour Fire SDC	
3Hour Fire SDC	
Aligning Line	
Aligning Line 1/8"	
Center	
Center 1/4"	
Centre	
Dash	
Dash 1.5mm	
Dash dot	
Dash dot dot	
Dash1	
Dash2	
Dash4	
Demolished	
Dot	
Dot 1mm	
Dot 2mm	
Double dash	
Grid Line	
Hidden	
IMPORT-ACAD_ISO0	
IMPORT-CENTER	
IMPORT-CON	
IMPORT-DASHED	
IMPORT-EP-LINE	
IMPORT-GLINE	
IMPORT-GLINE1	
IMPORT-HID1	
IMPORT-HID2	
IMPORT-HIDDEN	
IMPORT-HIDDENX2	
IMPORT-PHANTOM	
IMPORT-xc CI-S4-Ma	
Long Dash	
Long dash1	
Loose dash	
Mositure Barriers	
Overhead	
Rebar Cover Lines	
SDC-HIDDEN_1	
SDC-HIDDEN_2	
SDC-PHANTOM	
Triple dash	

11.12 View Filters

11.12.1 Architectural

Name	Categories	Filter By	Criteria	Value
Fire Rating – 30min	Ceilings Floors Doors Walls	Fire Designation	Contains	30
Fire Rating – 60min	Ceilings Floors Doors Walls	Fire Designation	Contains	60
Fire Rating – 90min	Ceilings Floors Doors Walls	Fire Designation	Contains	90
Fire Rating - None	Ceilings Floors Doors Walls	Fire Designation	Does Not Contain	
Acoustic - High	Ceilings Floors Doors Walls	Acoustic Designation	Is greater than or equal to	55
Acoustic - Low	Ceilings Floors Doors Walls	Acoustic Designation	Is less than	55
Acoustic - None	Ceilings Floors Doors Walls	Acoustic Designation	Does Not Contain	

11.12.2 Structural

Name	Categories	Filter By	Criteria	Value

11.12.3 MEP

Name	Categories	Filter By	Criteria	Value

11.13 Keyboard Shortcuts

Shortcuts marked can be launched using the first character followed by the Spacebar.

Home Tab

	Shortcut	Command
	WA	Build Wall
	DD	Build Door
	WW	Build Window
	CM	Place Component
	RR	Build Roof by Footprint
	RX	Build Roof by Extrusion
	CE	Build Ceiling
	FF	Build Floor
	CG	Define Curtain Grid
	ML	Place Curtain Mullion
	LI	Model Line (Visible in 3D)
	GP	Create Group from Selected Objects
	RA	Build Railing
	ST	Build Stair
	LL	Define Level
	GG	Define Gridline
	RD	Define Room
	RT	Tag Room
	WS	Set Work Plane
	RF	Define a Reference Plane

Insert Tab

Shortcut	Command
IL	Link Revit File
II	Link CAD File
LO	Load Family in from

Annotate Tab

Shortcut	Command
DS	Place Aligned Dimension
EL	Place a Spot Elevation Marker
DL	Detail Line (2D View Specific)
DC	Place a 2D Detail Component
RG	Define a 2D Repeating Detail String
IO	Draw Insulation Batt-Lines
TT	Define Text
F7	Spell-Check Text

Annotate Tab (Continued)

Shortcut	Command
TG	Place a Tag by Category
MT	Place a Multi-Category Tag
KK	Place a Keynote Tag by Element

Modify Tab

	MD or Esc-Esc	Modify
	PL	Paste Aligned - Select Levels by Name
	MA	Match Type Information
	AA	Align Objects
	TR	Trim Objects
	SX	Split Objects
	OO	Offset Lines or Walls
	TM	Measure Between Two References
	TA	Measure Along an Element
	JJ	Manipulate Wall-Join Configuration
	EE	Edit the Cut Profile
	LW	Modify Linework Appearance
	SF	Split Surface Material
	PT	Paint Surface Material

Collaborate Tab

	SS	Quick Synchronise with Central Model
	RL or RW	Reload Latest Changes from Central Model
	RQ	Relinquish All Worksets / Borrowed
	ER	View Outstanding Edit Requests

View Tab

□	VP	View Properties
□	AV	Apply View Template to the Current View
	CV	Create View Template from the Current View
	VV or VG	Visibility / Graphics Override Control
	TH	Toggle Thin Lines / WYSIWYG
□	3D	Open or Create a Default 3D View
	CX	Define a Camera View
□	CS	Define a Section View
	CA	Define a Callout View
	QS	Create a Schedule of Quantities
	CW	Close all Hidden Views
	WC	Cascade the Currently Open Views
	WT	Tile the Currently Open Views

Manage Tab

SU	Sun and Shadow Settings
MH	Call up the Materials / Textures Dialogue
UN	Modify Project Units

Contextual Tab

EP or PP	Element Properties
MM	Move Selected Elements
CO or CC	Copy Selected Elements
RO	Rotate Selected Elements
MI	Mirror Selected Elements
AR	Array Selected Elements
DE	Delete Selected Elements
AP	Add Element to Edited Group
AD	Attach a 2D Detail to the Edited Group
PG	Show Properties of Edited Group
FG	Finish Editing the Current Group
GC	Cancel Editing the Current Group
CR	Create Similar Object to that Selected
EH	Hide Element in this View
VH	Hide Category of Elements in this View
//	Divide Surface
EG	Edit Selected group
UG	Ungroup Selected Group
LG	Convert the Selected Group into a Linked Project
EW	Edit Witness Lines
EU	Unhide Hidden Elements
VU	Unhide Hidden Categories
EX	Exclude the Selected Item from this Group
RB	Restore the Selected Item to this Group
MP	Move Selected Element from Group to Project

View Control Bar

WF	Show Model in Wire-Frame
HL	Show Model with Hidden Lines
SD	Show Model Shaded with Edges
GD	Callup the Graphic Display Options Dialogue
RN	Callup the Rendering Dialogue
IC	Temporarily Isolate the Category of
HC	Temporarily Hide the Category of Elements
HI	Temporarily Isolate the Elements
HH	Temporarily Hide the Elements
HR	Reset All Temporarily Hide / Isolate
RH	Toggle Reveal Hidden Elements Mode

Navigation Bar

□	ZZ or ZR	Zoom into Region
	ZO or ZV	Zoom Out (x2)
	ZX, ZE or XF	Zoom to Fit Extents
	ZA	Zoom All Current Windows to Fit Extents
	ZS	Zoom to Sheet Size
	ZC or ZP	Revert to Previous Zoom / Pan

Snap Overrides

	SI	Snap to Intersections
	SE	Snap to Endpoints
	SM	Snap to Midpoints
	SC	Snap to Centres
	SN	Snap to Nearest
	SP	Snap to Perpendicular
	SG	Snap to Tangents
	SW	Snap to Work Plane Grid
	SQ	Snap to Quadrants
	SZ	Close Shape
	SO	Turn Snaps Off

General Purpose

□	QQ	Open Project, Family or Other Revit File
	QR	Create a New Project
□	NN	Create a New Family
	Ctrl-P	Print / Plot
	GB	Export Model to gbXML for Energy Assessment
□	XX	Close File
	Ctrl-S or QA	Save
	Ctrl-Z	Undo Previous Command(s)
	Ctrl-Y	Redo Command(s)
	Ctrl-□	Recapture Previous Selection
□	SA	Select All Similar Instances
	F1	Help
	Shift-F1	What's This?

11.14 Category Abbreviation Codes

Category	Code
Air Terminals	AIR
Ceilings	CLG
Columns	COL
Communication Devices	COM
Casework	CSW
Curtain Wall Mullions	CTM
Curtain Panels	CTP
Curtain Systems	CTS
Data Devices	DAT
Duct Accessories	DCA
Duct Fittings	DCF
Duct Insulations	DCI
Duct Linings	DCL
Ducts	DCT
Detail Items	DET
Doors	DOR
Electrical Equipment	ELE
Electrical Fixtures	ELF
Entourage	ENT
Fire Alarm Devices	FIR
Floors	FLR
Furniture	FRN
Furniture Systems	FRS
Flex Ducts	FXD
Flex Pipes	FXP
Generic Models	GEN
Lighting Devices	LGD
Lighting Fixtures	LGF
Mass	MAS
Mechanical Equipment	MEC
Nurse Call Devices	NRS
Plumbing Fixtures	PLM

Category	Code
Planting	PLN
Pipe Accessories	PPA
Pipe Fittings	PPF
Pipes	PPS
Parking	PRK
Roads	RDS
Railings	RLG
Ramps	RMP
Roofs	ROF
Structural Area Reinforcement	SAR
Structural Beam Systems	SBS
Structural Columns	SCL
Structural Connections	SCO
Security Devices	SEC
Structural Framing	SFA
Structural Foundations	SFO
Shaft Openings	SFT
Site	SIT
Structural Load Cases	SLC
Specialty Equipment	SPC
Sprinklers	SPK
Structural Path Reinforcement	SPR
Structural Rebar	SRB
Structural Stiffeners	SSF
Stairs	STA
Structural Trusses	STR
Telephone Devices	TEL
Topography	TOP
Windows	WDW
Wires	WIR
Walls	WLL

11.15 Shared Parameters

Group	Parameter Name	Type
Element Performance	Acoustic Designation	TEXT
	Acoustic Rating	TEXT
	Fire Designation	TEXT
Families	Uniclass	TEXT

LOD

Example of LOD matrix for Architectural Design

Components	Preliminary Design stage		Design stage	Detailed Design stage
	Requirements for LOD 100	Requirements for LOD 200	Requirements for LOD 300	Requirements for LOD 400
Wall	Wall type, approximate geometry	Precise dimensions, location, orientation	Exact visual representation, structure, material, slope, labeling, fire rating	Manufacturer specific details, part name, part number
Deck	Deck type, approximate geometry	Quantity, size, shape, location and orientation	Exact visual representation, structure, material, slope, labeling, fire rating	—
Floor	—	—	Type, exact dimensions, exact visual representation, construction of floor in layers with precise external dimensions	Manufacturer specific details, part name, part number
Column	Approximate geometry	Column type, precise dimensions, location	Exact visual representation, section/ profile, construction, material, space, labeling, precise dimensions	—
Ceiling	—	—	Ceiling type, approximate geometry, exact dimensions, exact visual representation, construction, location,	Part name, part number

			material, slope, space, labeling, manufacturer	
Window	Approximate geometry	Type, location	Exact dimensions, exact visual representation, frame and sash, fittings/ accessories, material, labeling	_
Door	Approximate geometry	Type, location	Exact dimensions, exact visual representation, frame and door leaf, handle, material, labeling, manufacturer, fire rating	_
Staircase	Approximate geometry	Location	Type, exact dimensions, construction, material, slope, labeling	_
Landing	Approximate geometry	Type, location	Exact dimensions, construction, material, labeling	_
Handrails	Approximate geometry	_	Type, exact dimensions, exact visual representation, construction, location, fittings/ accessories, material, labeling	Section/ profile, manufacturer, part name, part number
Heavy facade	Approximate geometry	_	Type, exact dimensions, exact visual representation, detailed construction, location, fittings/ accessories, material, labeling	Section/ profile, manufacturer
Impost	Approximate geometry	_	Type, exact dimensions, exact visual representation, construction, location, material, labeling	Section/ profile, manufacturer
Roof	Approximate geometry	Type, location, Space	Exact dimensions, construction, material, slope, labeling, fire rating	_

Plumbing fixtures	Approximate geometry	Location	Type, exact dimensions, exact visual representation, fittings/ accessories, labeling	Part name, part number
Light facade	Approximate geometry	—	Type, exact dimensions, exact visual representation, detailed construction, location, material, slope, labeling	Section/ profile, fittings/ accessories, manufacturer, part name, part number
Entrance ramp		—	Type, exact dimensions, construction, location, material, slope, labeling	Section/ profile
Room	Approximate geometry	Type, area	Exact dimensions, labeling	—

Clash Detection Methodology

The following section contains Clashes Detection Methodology in terms of Levels of applying and Follow up through project life cycle and based on Interference reports from Revit.

---

1. Levels of Clashes:

Level One Clashes

Clashes in these categories are considered the most critical to the coordination process. They usually relate to more costly systems or construction techniques that are more costly to delay or reschedule.

A. Mechanical Ductwork and Piping vs. Ceilings
B. Mechanical Ductwork and Piping vs. Rated Walls (for coordination of dampers and other mechanical equipment needs)
C. Mechanical Ductwork and Piping vs. Structure (columns, beams, framing, etc.)
D. All Equipment and Their Applicable Clearances vs. Walls
E. All Equipment and Their Applicable Clearances vs. Structure
F. Mechanical Equipment and Fixtures vs. Electrical Equipment and Fixtures
G. Mechanical Ductwork and Piping vs. Plumbing Piping

Level Two Clashes

These categories of clashes are considered important to the design and construction process, but are less critical than those designated as Level One.

A. Casework vs. Electrical Fixtures and Devices
B. Furnishings vs. Electrical Fixtures and Devices
C. Structure vs. Specialty Equipment
D. Structure vs. Electrical Equipment, Fixtures, and Devices
E. Ductwork and Piping vs. Electrical Equipment, Fixtures, and Devices
F. Ductwork vs. Floors

Level Three Clashes

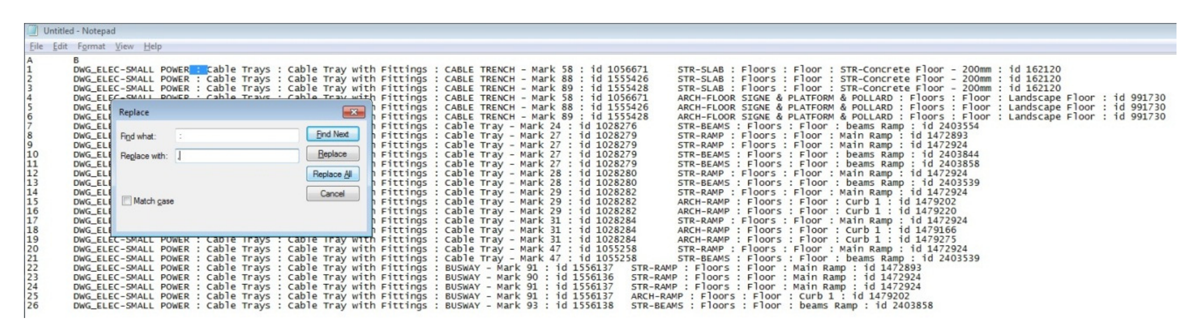
These clashes are considered important to the correctness of the model; however, they will usually Change on a regular basis throughout the design and construction process.

A. Casework vs. Walls
B. Plumbing Piping vs. Electrical Equipment, Fixtures, and Devices
C. Plumbing Piping vs. Mechanical Equipment, Fixtures, and Devices
D. ADA Clear Space Requirements vs. Doors, Fixtures, Walls, Structure

2. Managing Project Clashes:

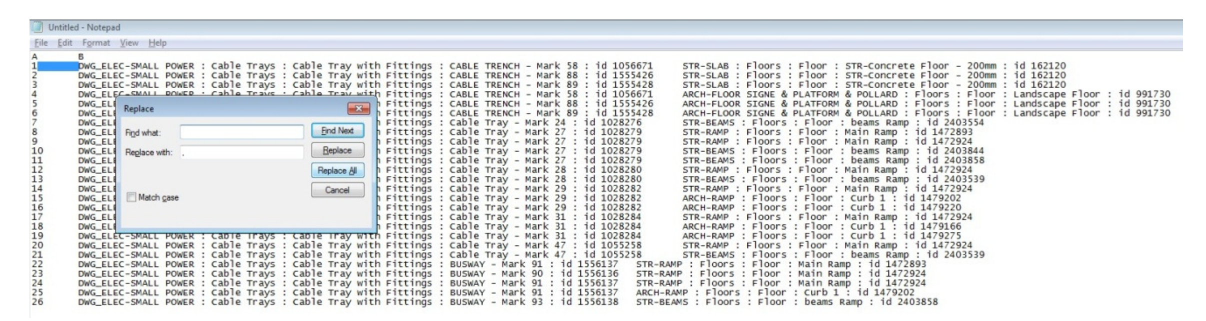
CSV File creation & Editing:

a. Copy Interference report contents to Notepad.
b. **Copy** the “space colon space” “ : “as highlighted in image below.
c. **Press** Ctrl + H then **paste** in the “Find What” Field.
d. **Type** Coma “,” in the “Replace with” field then **click** “replace all”.




```
A        B
1        DWG_ELEC-SMALL POWER : Cable Trays : Cable Tray with Fittings : CABLE TRENCH - Mark 58 : id 1056671     STR-SLAB : Floors : Floor : STR-Concrete Floor - 200mm : id 162120
2        DWG_ELEC-SMALL POWER : Cable Trays : Cable Tray with Fittings : CABLE TRENCH - Mark 88 : id 1555426     STR-SLAB : Floors : Floor : STR-Concrete Floor - 200mm : id 162120
3        DWG_ELEC-SMALL POWER : Cable Trays : Cable Tray with Fittings : CABLE TRENCH - Mark 89 : id 1555428     STR-SLAB : Floors : Floor : STR-Concrete Floor - 200mm : id 162120
4        DWG_EL… Fittings : CABLE TRENCH - Mark 58 : id 1056671     ARCH-FLOOR SIGNE & PLATFORM & POLLARD : Floors : Floor : Landscape Floor : id 991730
5        DWG_EL… Fittings : CABLE TRENCH - Mark 88 : id 1555426     ARCH-FLOOR SIGNE & PLATFORM & POLLARD : Floors : Floor : Landscape Floor : id 991730
6        DWG_EL… Fittings : CABLE TRENCH - Mark 89 : id 1555428     ARCH-FLOOR SIGNE & PLATFORM & POLLARD : Floors : Floor : Landscape Floor : id 991730
7        DWG_EL… Fittings : Cable Tray - Mark 24 : id 1028276     STR-BEAMS : Floors : Floor : beams Ramp : id 2403554
8        DWG_EL… Fittings : Cable Tray - Mark 27 : id 1028279     STR-RAMP : Floors : Floor : Main Ramp : id 1472893
9        DWG_EL… Fittings : Cable Tray - Mark 27 : id 1028279     STR-RAMP : Floors : Floor : Main Ramp : id 1472924
10       DWG_EL… Fittings : Cable Tray - Mark 27 : id 1028279     STR-BEAMS : Floors : Floor : beams Ramp : id 2403844
11       DWG_EL… Fittings : Cable Tray - Mark 27 : id 1028279     STR-BEAMS : Floors : Floor : beams Ramp : id 2403858
12       DWG_EL… Fittings : Cable Tray - Mark 28 : id 1028280     STR-RAMP : Floors : Floor : Main Ramp : id 1472924
13       DWG_EL… Fittings : Cable Tray - Mark 28 : id 1028280     STR-BEAMS : Floors : Floor : beams Ramp : id 2403539
14       DWG_EL… Fittings : Cable Tray - Mark 29 : id 1028282     STR-RAMP : Floors : Floor : Main Ramp : id 1472924
15       DWG_EL… Fittings : Cable Tray - Mark 29 : id 1028282     ARCH-RAMP : Floors : Floor : Curb 1 : id 1479202
16       DWG_EL… Fittings : Cable Tray - Mark 29 : id 1028282     ARCH-RAMP : Floors : Floor : Curb 1 : id 1479220
17       DWG_EL… Fittings : Cable Tray - Mark 31 : id 1028284     STR-RAMP : Floors : Floor : Main Ramp : id 1472924
18       DWG_EL… Fittings : Cable Tray - Mark 31 : id 1028284     ARCH-RAMP : Floors : Floor : Curb 1 : id 1479166
19       DWG_ELEC-SMALL POWER : Cable Trays : Cable Tray with Fittings : Cable Tray - Mark 31 : id 1028284     ARCH-RAMP : Floors : Floor : Curb 1 : id 1479275
20       DWG_ELEC-SMALL POWER : Cable Trays : Cable Tray with Fittings : Cable Tray - Mark 47 : id 1055258     STR-RAMP : Floors : Floor : Main Ramp : id 1472924
21       DWG_ELEC-SMALL POWER : Cable Trays : Cable Tray with Fittings : Cable Tray - Mark 47 : id 1055258     STR-BEAMS : Floors : Floor : beams Ramp : id 2403539
22       DWG_ELEC-SMALL POWER : Cable Trays : Cable Tray with Fittings : BUSWAY - Mark 91 : id 1556137   STR-RAMP : Floors : Floor : Main Ramp : id 1472893
23       DWG_ELEC-SMALL POWER : Cable Trays : Cable Tray with Fittings : BUSWAY - Mark 90 : id 1556136   STR-RAMP : Floors : Floor : Main Ramp : id 1472924
24       DWG_ELEC-SMALL POWER : Cable Trays : Cable Tray with Fittings : BUSWAY - Mark 91 : id 1556137   STR-RAMP : Floors : Floor : Main Ramp : id 1472924
25       DWG_ELEC-SMALL POWER : Cable Trays : Cable Tray with Fittings : BUSWAY - Mark 91 : id 1556137   ARCH-RAMP : Floors : Floor : Curb 1 : id 1479202
26       DWG_ELEC-SMALL POWER : Cable Trays : Cable Tray with Fittings : BUSWAY - Mark 93 : id 1556138   STR-BEAMS : Floors : Floor : beams Ramp : id 2403858
```

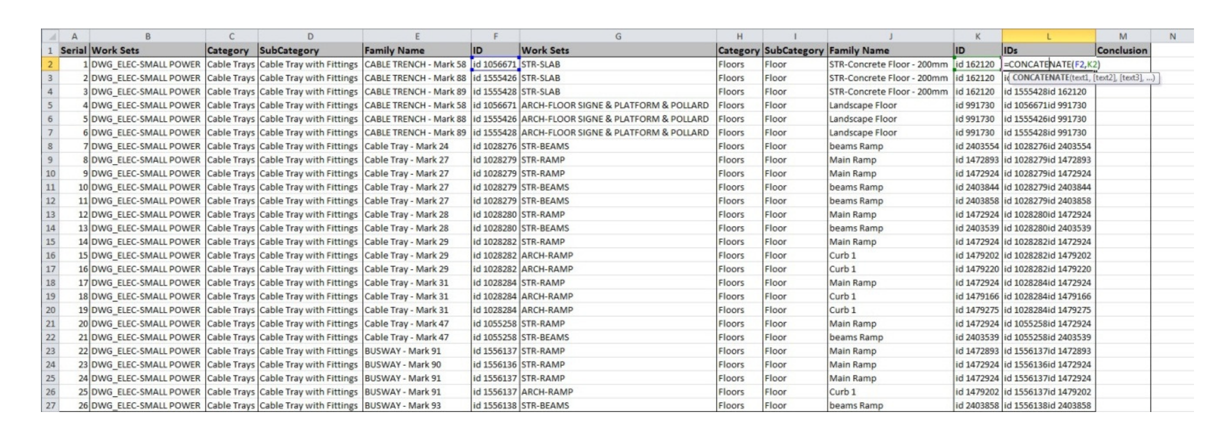
e. Repeat above steps for “space tab” “ “as highlighted in image below.



f. Save the file as coma delimited “*.csv”.
g. Open the “*.csv” file in excel and resave it as “*.xlsx”.

Editing Excel Files:

a. Rename Headers as in image below.

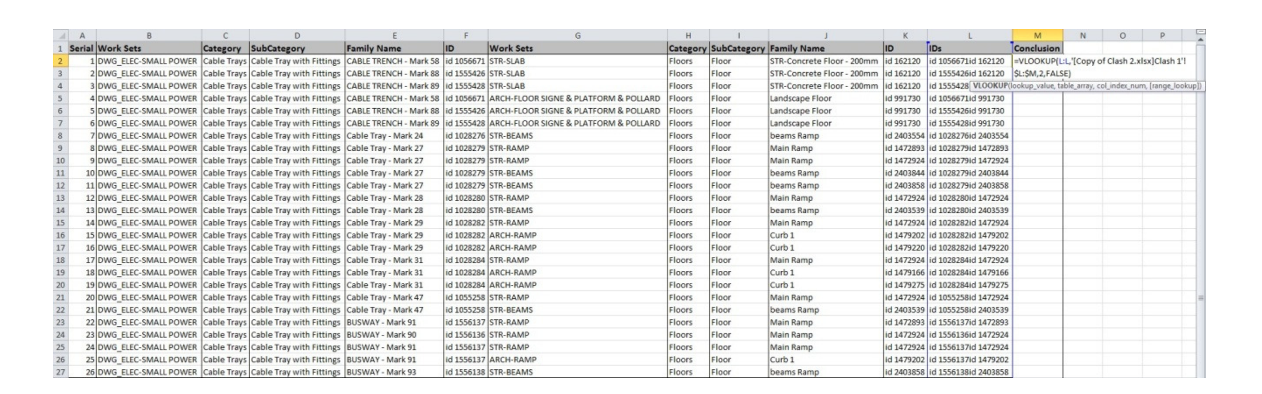


	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Serial	Work Sets	Category	SubCategory	Family Name	ID	Work Sets	Category	SubCategory	Family Name	ID	IDs	Conclusion	
2	1	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	CABLE TRENCH - Mark 58	id 1056671	STR-SLAB	Floors	Floor	STR-Concrete Floor - 200mm	id 162120	=CONCATENATE(F2,K2)		
3	2	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	CABLE TRENCH - Mark 88	id 1555426	STR-SLAB	Floors	Floor	STR-Concrete Floor - 200mm	id 162120	CONCATENATE(text1, [text2], [text3], ...)		
4	3	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	CABLE TRENCH - Mark 89	id 1555428	STR-SLAB	Floors	Floor	STR-Concrete Floor - 200mm	id 162120	id 1555428id 162120		
5	4	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	CABLE TRENCH - Mark 58	id 1056671	ARCH-FLOOR SIGNE & PLATFORM & POLLARD	Floors	Floor	Landscape Floor	id 991730	id 1056671id 991730		
6	5	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	CABLE TRENCH - Mark 88	id 1555426	ARCH-FLOOR SIGNE & PLATFORM & POLLARD	Floors	Floor	Landscape Floor	id 991730	id 1555426id 991730		
7	6	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	CABLE TRENCH - Mark 89	id 1555428	ARCH-FLOOR SIGNE & PLATFORM & POLLARD	Floors	Floor	Landscape Floor	id 991730	id 1555428id 991730		
8	7	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	Cable Tray - Mark 24	id 1028276	STR-BEAMS	Floors	Floor	beams Ramp	id 2403554	id 1028276id 2403554		
9	8	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	Cable Tray - Mark 27	id 1028279	STR-RAMP	Floors	Floor	Main Ramp	id 1472893	id 1028279id 1472893		
10	9	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	Cable Tray - Mark 27	id 1028279	STR-RAMP	Floors	Floor	Main Ramp	id 1472924	id 1028279id 1472924		
11	10	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	Cable Tray - Mark 27	id 1028279	STR-BEAMS	Floors	Floor	beams Ramp	id 2403844	id 1028279id 2403844		
12	11	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	Cable Tray - Mark 27	id 1028279	STR-BEAMS	Floors	Floor	beams Ramp	id 2403858	id 1028279id 2403858		
13	12	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	Cable Tray - Mark 28	id 1028280	STR-RAMP	Floors	Floor	Main Ramp	id 1472924	id 1028280id 1472924		
14	13	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	Cable Tray - Mark 28	id 1028280	STR-BEAMS	Floors	Floor	beams Ramp	id 2403539	id 1028280id 2403539		
15	14	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	Cable Tray - Mark 29	id 1028282	STR-RAMP	Floors	Floor	Main Ramp	id 1472924	id 1028282id 1472924		
16	15	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	Cable Tray - Mark 29	id 1028282	ARCH-RAMP	Floors	Floor	Curb 1	id 1479202	id 1028282id 1479202		
17	16	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	Cable Tray - Mark 29	id 1028282	ARCH-RAMP	Floors	Floor	Curb 1	id 1479220	id 1028282id 1479220		
18	17	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	Cable Tray - Mark 31	id 1028284	STR-RAMP	Floors	Floor	Main Ramp	id 1472924	id 1028284id 1472924		
19	18	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	Cable Tray - Mark 31	id 1028284	ARCH-RAMP	Floors	Floor	Curb 1	id 1479166	id 1028284id 1479166		
20	19	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	Cable Tray - Mark 31	id 1028284	ARCH-RAMP	Floors	Floor	Curb 1	id 1479275	id 1028284id 1479275		
21	20	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	Cable Tray - Mark 47	id 1055258	STR-RAMP	Floors	Floor	Main Ramp	id 1472924	id 1055258id 1472924		
22	21	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	Cable Tray - Mark 47	id 1055258	STR-BEAMS	Floors	Floor	beams Ramp	id 2403539	id 1055258id 2403539		
23	22	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	BUSWAY - Mark 91	id 1556137	STR-RAMP	Floors	Floor	Main Ramp	id 1472893	id 1556137id 1472893		
24	23	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	BUSWAY - Mark 90	id 1556136	STR-RAMP	Floors	Floor	Main Ramp	id 1472924	id 1556136id 1472924		
25	24	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	BUSWAY - Mark 91	id 1556137	STR-RAMP	Floors	Floor	Main Ramp	id 1472924	id 1556137id 1472924		
26	25	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	BUSWAY - Mark 91	id 1556137	ARCH-RAMP	Floors	Floor	Curb 1	id 1479202	id 1556137id 1479202		
27	26	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	BUSWAY - Mark 93	id 1556138	STR-BEAMS	Floors	Floor	beams Ramp	id 2403858	id 1556138id 2403858		

b. In cell “L2” use the following formula to group the IDs of both clashing elements to create a Primary Key for each clash record to ease the clashes follow up “=CONCATENATE (F2,K2)”
c. Copy cell “L2” contents and paste it in below cells to repeat the same function on for all record.
d. Add conclusion of the clash review in column “M”.
e. Note to name the files as per the following naming convention “Date_Categories1_Categories2” while Date is in the following order “Day Month Year”.For example “141012_CableTarys_Floors”.

Follow up clashes through project life cycle:

a. To compare clashes progress between two reports we have to make sure that the primary key exists in both reports as in steps 2.2 & 2.3 then we use the following formula “=VLOOKUP(L:L,'[Old Report File Name.xlsx]Sheet Name'!$L:$M,2,FALSE)” in cell “M2” to transfer conclusion from the old report to the new one by mapping with the Primary Key. Note to use file nameand Sheet Namefrom the old report instead of the underlined part of the formula.



Serial	Work Sets	Category	SubCategory	Family Name	ID	Work Sets	Category	SubCategory	Family Name	ID	IDs	Conclusion
1	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	CABLE TRENCH - Mark 58	id 1056671	STR-SLAB	Floors	Floor	STR-Concrete Floor - 200mm	id 162120	id 1056671id 162120	=VLOOKUP(L:L,'[Copy of Clash 2.xlsx]Clash 1'!$L:$M,2,FALSE)
2	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	CABLE TRENCH - Mark 88	id 1555426	STR-SLAB	Floors	Floor	STR-Concrete Floor - 200mm	id 162120	id 1555426id 162120	
3	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	CABLE TRENCH - Mark 89	id 1555428	STR-SLAB	Floors	Floor	STR-Concrete Floor - 200mm	id 162120	id 1555428	VLOOKUP(lookup_value, table_array, col_index_num, [range_lookup])
4	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	CABLE TRENCH - Mark 58	id 1056671	ARCH-FLOOR SIGNE & PLATFORM & POLLARD	Floors	Floor	Landscape Floor	id 991730	id 1056671id 991730	
5	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	CABLE TRENCH - Mark 88	id 1555426	ARCH-FLOOR SIGNE & PLATFORM & POLLARD	Floors	Floor	Landscape Floor	id 991730	id 1555426id 991730	
6	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	CABLE TRENCH - Mark 89	id 1555428	ARCH-FLOOR SIGNE & PLATFORM & POLLARD	Floors	Floor	Landscape Floor	id 991730	id 1555428id 991730	
7	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	Cable Tray - Mark 24	id 1028276	STR-BEAMS	Floors	Floor	beams Ramp	id 2403554	id 1028276id 2403554	
8	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	Cable Tray - Mark 27	id 1028279	STR-RAMP	Floors	Floor	Main Ramp	id 1472893	id 1028279id 1472893	
9	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	Cable Tray - Mark 27	id 1028279	STR-RAMP	Floors	Floor	Main Ramp	id 1472924	id 1028279id 1472924	
10	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	Cable Tray - Mark 27	id 1028279	STR-BEAMS	Floors	Floor	beams Ramp	id 2403844	id 1028279id 2403844	
11	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	Cable Tray - Mark 27	id 1028279	STR-BEAMS	Floors	Floor	beams Ramp	id 2403858	id 1028279id 2403858	
12	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	Cable Tray - Mark 28	id 1028280	STR-RAMP	Floors	Floor	Main Ramp	id 1472924	id 1028280id 1472924	
13	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	Cable Tray - Mark 28	id 1028280	STR-BEAMS	Floors	Floor	beams Ramp	id 2403539	id 1028280id 2403539	
14	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	Cable Tray - Mark 29	id 1028282	STR-RAMP	Floors	Floor	Main Ramp	id 1472924	id 1028282id 1472924	
15	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	Cable Tray - Mark 29	id 1028282	ARCH-RAMP	Floors	Floor	Curb 1	id 1479202	id 1028282id 1479202	
16	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	Cable Tray - Mark 29	id 1028282	ARCH-RAMP	Floors	Floor	Curb 1	id 1479220	id 1028282id 1479220	
17	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	Cable Tray - Mark 31	id 1028284	STR-RAMP	Floors	Floor	Main Ramp	id 1472924	id 1028284id 1472924	
18	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	Cable Tray - Mark 31	id 1028284	ARCH-RAMP	Floors	Floor	Curb 1	id 1479166	id 1028284id 1479166	
19	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	Cable Tray - Mark 31	id 1028284	ARCH-RAMP	Floors	Floor	Curb 1	id 1479275	id 1028284id 1479275	
20	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	Cable Tray - Mark 47	id 1055258	STR-RAMP	Floors	Floor	Main Ramp	id 1472924	id 1055258id 1472924	
21	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	Cable Tray - Mark 47	id 1055258	STR-BEAMS	Floors	Floor	beams Ramp	id 2403539	id 1055258id 2403539	
22	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	BUSWAY - Mark 91	id 1556137	STR-RAMP	Floors	Floor	Main Ramp	id 1472893	id 1556137id 1472893	
23	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	BUSWAY - Mark 90	id 1556136	STR-RAMP	Floors	Floor	Main Ramp	id 1472924	id 1556136id 1472924	
24	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	BUSWAY - Mark 91	id 1556137	STR-RAMP	Floors	Floor	Main Ramp	id 1472924	id 1556137id 1472924	
25	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	BUSWAY - Mark 91	id 1556137	ARCH-RAMP	Floors	Floor	Curb 1	id 1479202	id 1556137id 1479202	
26	DWG_ELEC-SMALL POWER	Cable Trays	Cable Tray with Fittings	BUSWAY - Mark 93	id 1556138	STR-BEAMS	Floors	Floor	beams Ramp	id 2403858	id 1556138id 2403858	

b. Repeat step 2.3 on the column “M” to repeat the formula.

Autodesk Revit Model Validation Checklist

Project	
Central file name	
Date	
Prepared By	
Approved By	
Standard	

Positive results ☐ of 38

Negative results ☐ of 38

No	Description	Criterion (reference)	Result		Comment
			Yes	No	
Location and parameters					
1	The coordinates of the survey correspond to the base file				
2	The coordinates of the base point of the project correspond to the base file				
3	The axis and levels correspond to the architectural model file				
4	Model elements comply with LOD (G)				
5	No duplicated and superimposed elements (no messages in the Revit log)				
Data					
6	The folder structure of the project complies with the standard				
7	General parameters comply with the standard				
8	A standard project template is used				
9	Model elements comply with LOD (LOI)				
10	The elements are placed correctly on the worksets				
	Names comply with the standard:				
11	- Model file				
12	- Families				
13	- Types				
14	- Worksets				
15	- Parameters				
16	- Views				
17	- View templates				
18	- Filters				
19	- Levels				
20	- Hatches				
21	- Fills				
22	- Sheets				
23	- Line types				
24	- Line styles				
25	- Materials				
26	- Grid lines				
27	- Text styles				
28	- Dimension styles				

29	- Stages				
30	- Arrows				
31	Sheet elements correspond to the standard template				
32	Schedules correspond to the standard template				
33	Text styles correspond to the standard template				
34	Dimension styles correspond to the standard template				
35	Line weights correspond to the standard template				
36	Line types correspond to the standard template				
37	There are no unused family				
3D coordination					
38	There are no conflicts with models in other parts of the project				

Recommendations on Using Autodesk Navisworks® Manage for Clash Detection

1 Model Preparation by Discipline

Preparation of models for each discipline assumes their spatial coordination. See sections 5.8.6 and 5.8.7 of this Standard.

In addition to the spatial coordination, the following actions are recommended:

- Setting options of the model export from Revit® to the NWC file format
- Setting options of the RVT file import in Navisworks®
- Optimization of the Navisworks® performance
- Creating views to be exported
- Creating and assigning the additional design parameters

1.1 Setting Options of the Model Export from Revit® to the NWC File Format

Export options are set up in *Navisworks Options Editor – Revit* dialog box (Fig.15)

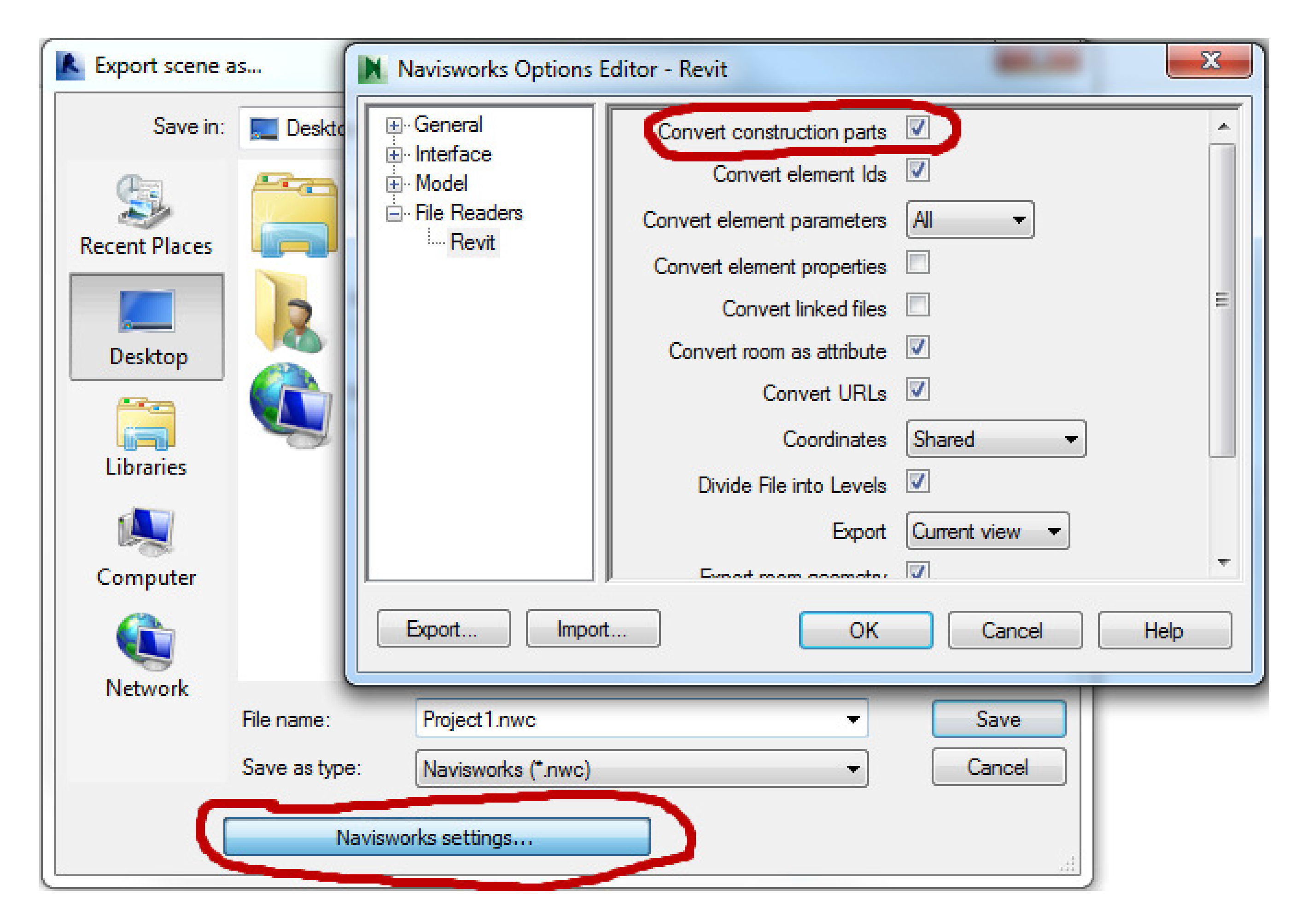


Fig. 15. An example of the export module settings in Navisworks®

Convert Element Parameters – All: enables access to all Revit® model element properties in Navisworks®.

Export – Current view: allows to prepare several views in Revit® and generate the needed amount of compound NWC models.

1.2 Setting Options of the RVT File Import in Navisworks®

An example of settings is shown in Fig.16.

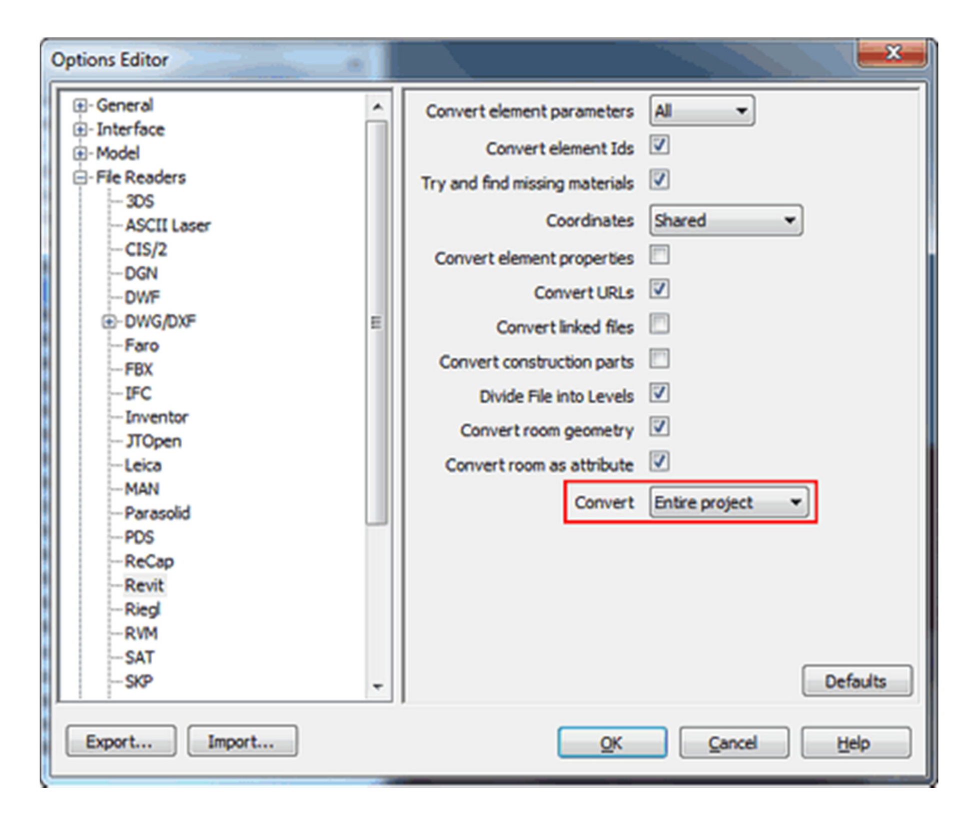


Fig.16. An example of the RVT import settings in Navisworks®

1.3 Optimization of the Navisworks® Performance

When the NWC is opened in Navisworks®, it becomes write-protected, so users cannot edit, replace or delete it. In order to have the NWC file updated during the NWF loading into the opened federated model, you need to check the *Close NWC/NWD files on Load* option (see Fig.17).

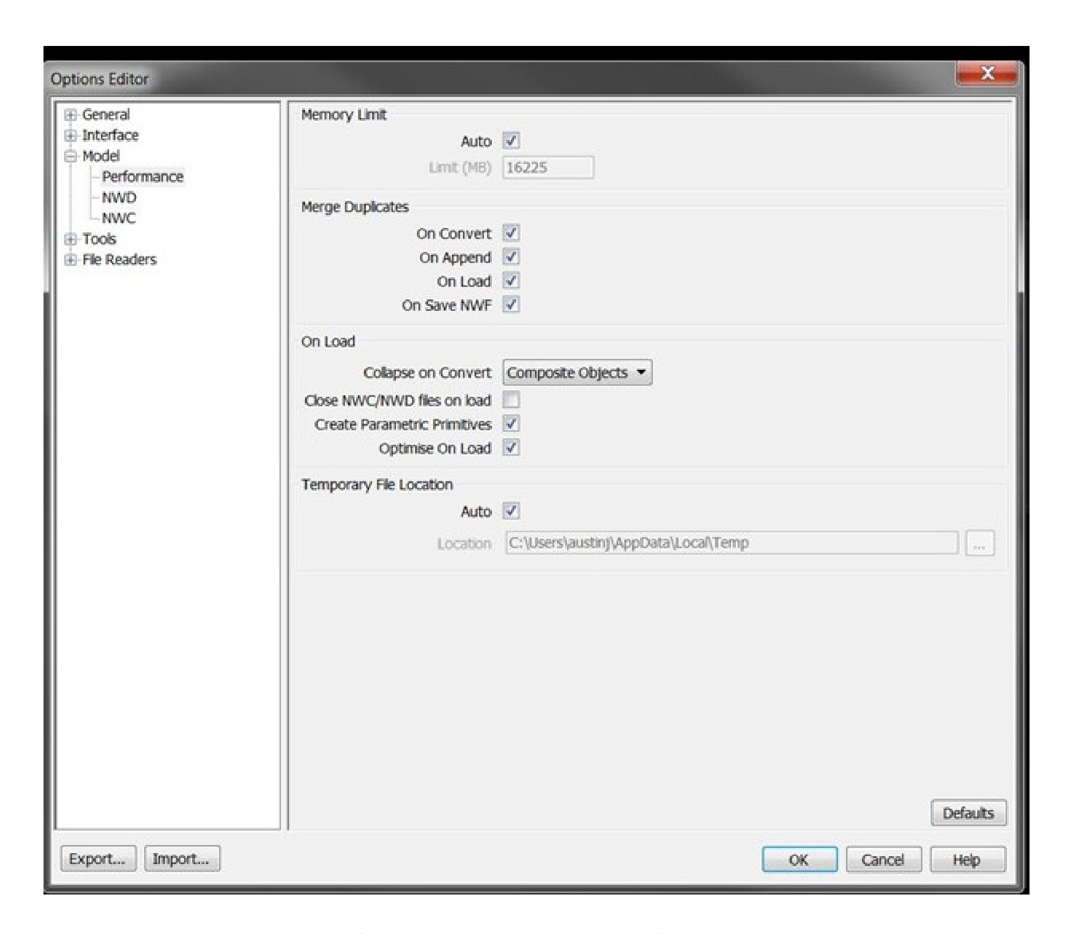


Fig. 17. Optimization of the Navisworks® performance

1.4 Creating Views to be Exported

It is recommended to create separate views in Revit® for exporting the model to Navisworks®. Only those elements that are needed for clash checks shall be displayed in such views.

View templates shall be used in order to quickly apply the view settings.

1.5 Creating and assigning the additional design parameters

It is recommended to create the additional design parameters in Revit®. That shall enable quick selection of model elements in Navisworks®, when needed.

Parameter naming scheme shall ensure their quick and unambiguous identification in the Navisworks® environment (for instance, they all may have the “NW_” prefix) when using the model element search tool.

Using parameters speeds up the creation of search sets.

2 Model Export by Discipline – Transferring Data to Navisworks®

The following ways are recommended for transferring a BIM model from Revit®:

- Direct export from Revit® into NWC format using the utility which is added to Revit® during the Navisworks® install
- Import the Revit® design file (RVT) in Navisworks®
- Batch creation of NWD files using the *Batch Utility*.

2.1 Exporting Models from Revit® into NWC Format

The recommended export settings are shown in Fig. 15.

Before the export operation, the view that has been set up for exporting to Navisworks® shall be opened.

The export module shall be called, as seen in Fig. 18.

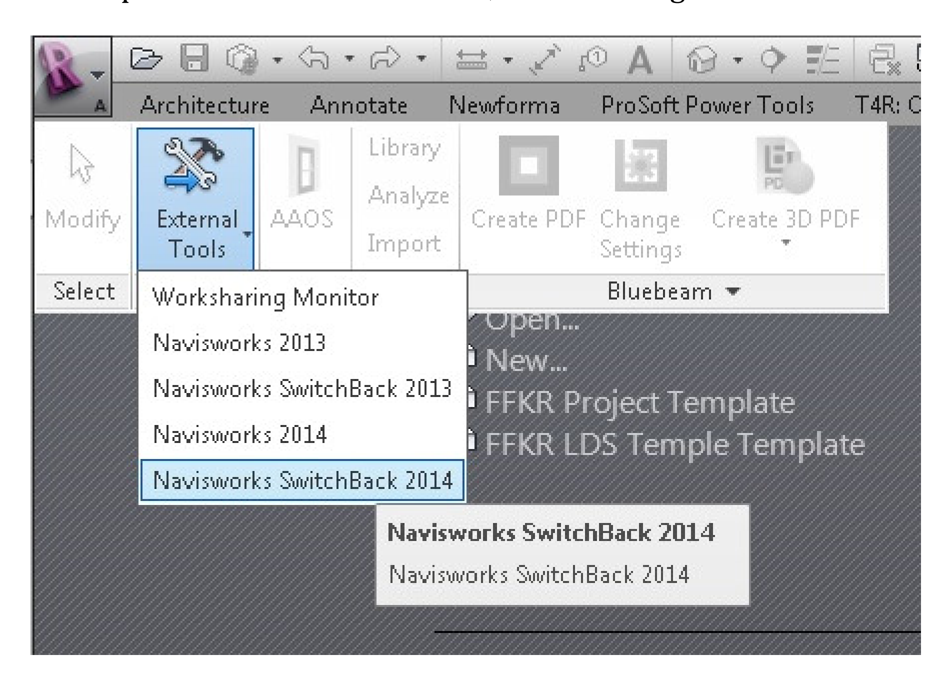


Fig.18. The NWC Export command

When you execute the NWC export command once again, use the same target file name. If you do so, updating the federated model would be just enough to incorporate the latest modifications of the BIM model.

2.2 Import the Revit® Project File (RVT) in Navisworks®

Before importing the Revit® project file, make sure that there is a view with “Navisworks” substring in its name and that the view has been set up for export.

The RVT import settings in Navisworks® are shown in Fig. 16 of this Appendix.

2.3 Batch creation of NWD files

Batch creation of NWD files shall be performed using the *Batch Utility* (Fig.19).

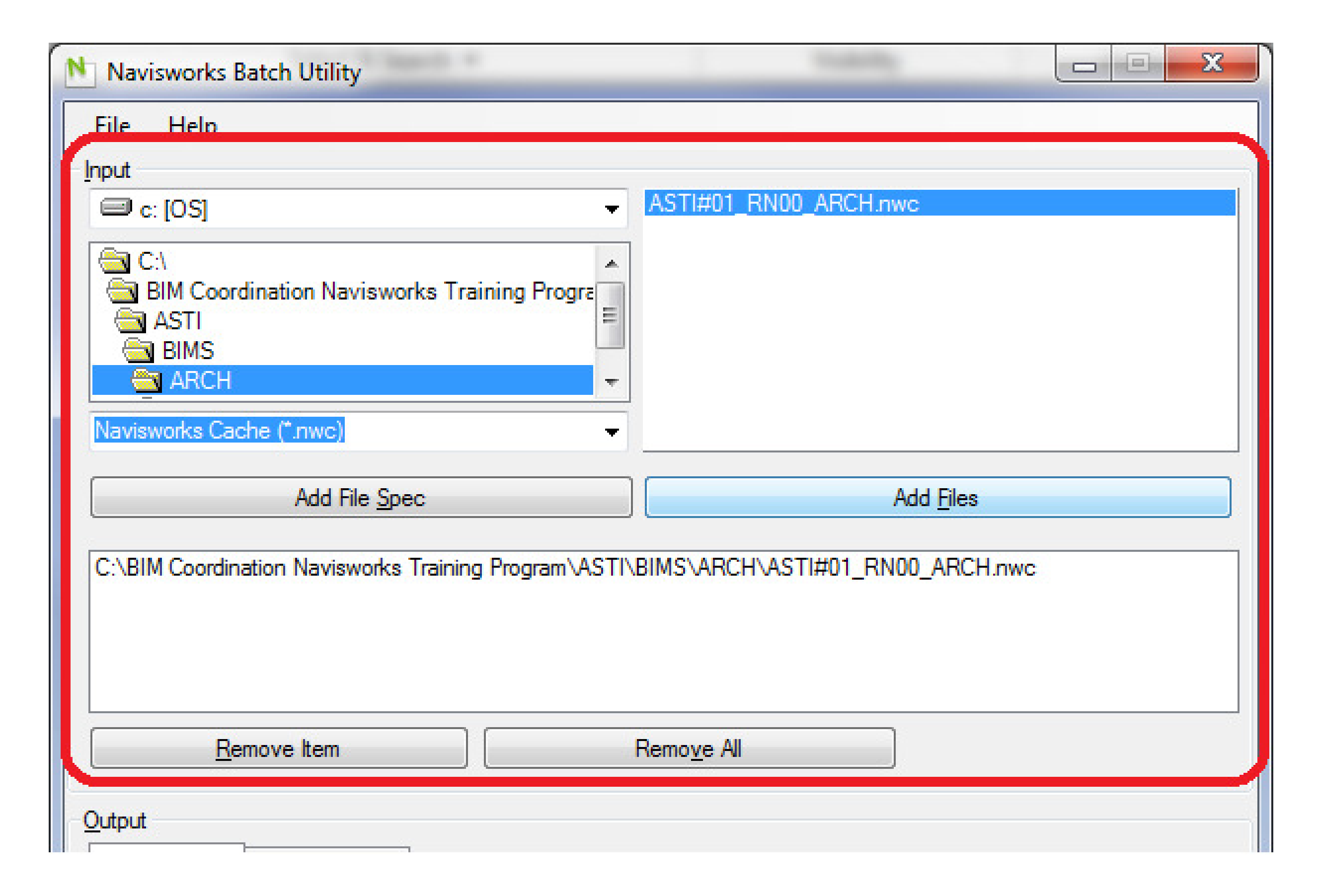


Fig.19. The **Batch Utility** main window

NWD files can be used for creating the federated model in the same way, as the NWC files.

3 Creating the Federated Model

The federated model shall be created using the *Append* command (Fig. 20).

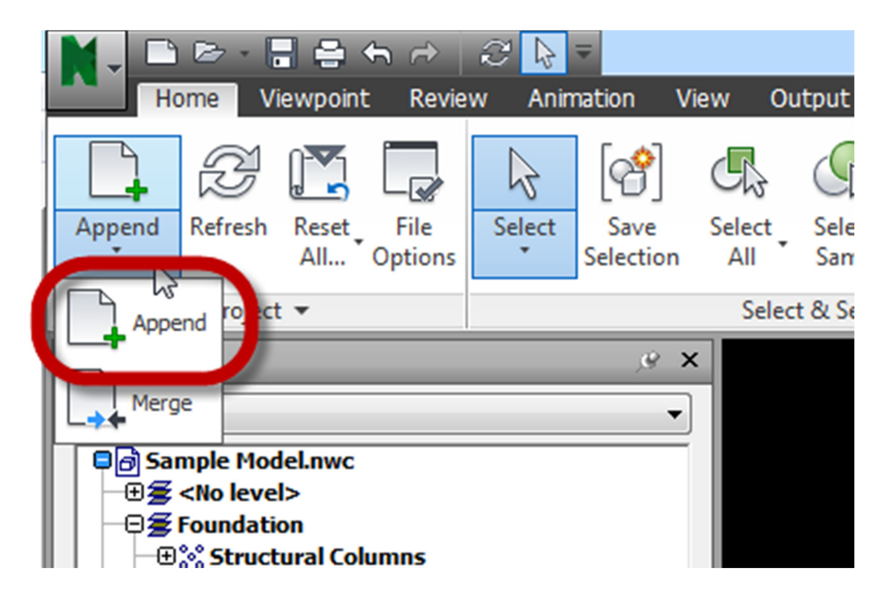


Fig.20. Calling the *Append* command

The federated model details are displayed in the selection tree.

3.1 Recommendations on working with the federated model

The Navisworks® federated model shall be saved in the NWF format, which is the main working format in the product. NWF file contain links to discipline models, saved viewpoints, selection sets and search sets, all comments and tags, animation etc., that is, the complete content that was generated in Navisworks®.

3.1.1 Documenting Actions with the Federated Model

The main Navisworks® working format, NWF, contains the actual data only.

If you need to keep the history of the federated model, use the NWD format that holds all snapshots of the BIM model inside.

NWD save interval shall be defined in BEP. In addition to the Navisworks®-originated content, elements of all models are physically represented in this format.

3.1.2 Working with Large BIM Models

Large BIM models can be divided into portions that are smaller and better manageable. You may have, for instance, a separate model for each building within the project.

In order to better manage the federated model, creation of intermediate NWD files where elements are grouped by discipline is allowed. An example of such model structure is shown in Fig.21.

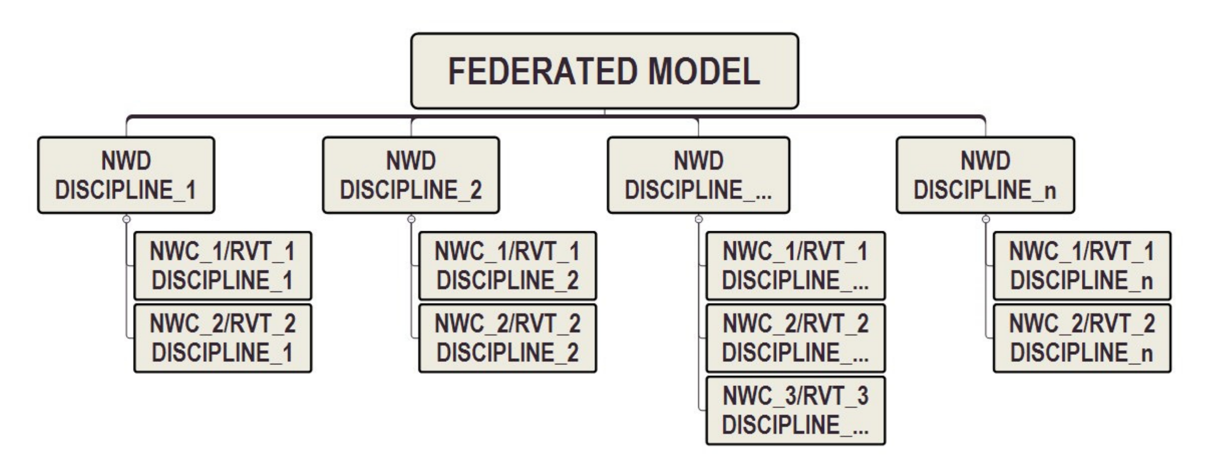


Fig.21. An example of the large federated model structure

4 Creating Selection Sets and Search Sets on the Basis of the Clash Matrix

4.1 Clash Matrix

The Clash matrix shall be created in accordance with the check priorities.

- **Priority 1**: Critical clashes that shall be resolved as early as possible in the design process (clashes between air ducts and walls, etc.)
- **Priority 2**: Major clashes that shall be resolved at the coordination meetings in the design process (clashes between structural elements and electric equipment, etc.)
- **Priority 3**: Less severe clashes that shall be resolved on a regular basis in the design and construction process (clashes between water supply systems and mechanical equipment, etc.)

The priority of checks may vary, depending on the particular project and its tasks.

A template of the clash matrix is shown in Fig.22.

МАТРИЦА КОЛЛИЗИЙ	Architectural					Structural					Heating				Ventilation					Plumbing				Electrical		
	Walls	Curtain walls/systems	Floors	Ceilings	Doors	Slabs	Roofs	Columns	Structural Framing	Structural Connections	Mechanical Equipment	Pipes	Pipe Accessories	Pipe Fittings	Air Terminals	Ducts	Duct Fittings	Duct Accessories	Mechanical Equipment	Plumbing Fixture	Pipes	Pipe Accessories	Pipe Fittings	Lighting Fixtures	Electrical Equipment	Cable Trays/Conduits
Architectural																										
Walls																										
Curtain walls/systems																										
Floors																										
Ceilings																										
Doors																										
Structural																										
Walls																										
Slabs																										
Roofs																										
Columns																										
Structural Framing																										
Structural Connections																										
Heating																										
Mechanical Equipment																										
Pipes																										
Pipe Accessories																										
Pipe Fittings																										
Ventilation																										
Air Terminals																										
Ducts																										
Duct Fittings																										
Duct Accessories																										
Mechanical Equipment																										
Plumbing																										
Plumbing Fixture																										
Pipes																										
Pipe Accessories																										
Pipe Fittings																										
Electrical																										
Lighting Fixtures																										
Electrical Equipment																										
Cable Trays/Conduits																										

Fig.22. A sample template of the clash matrix

For each particular project, you shall mark the fields that define the groups of elements to check, keeping in mind the priority of checks. See Fig.10 in this Standard.

The completed matrix becomes an integral part of BEP.

4.2 Creating Selection Sets and Search Sets

Creation of selection sets and search sets for clash checking is supported in both Navisworks® Manage and Navisworks® Simulate. Search sets can be exported from Navisworks® Simulate to Navisworks® Manage using the XML format.

Creation of selection sets and search sets shall be based on the clash matrix that defines the groups of BIM model elements to check.

Model element properties shall be included in the search (see Fig.23).

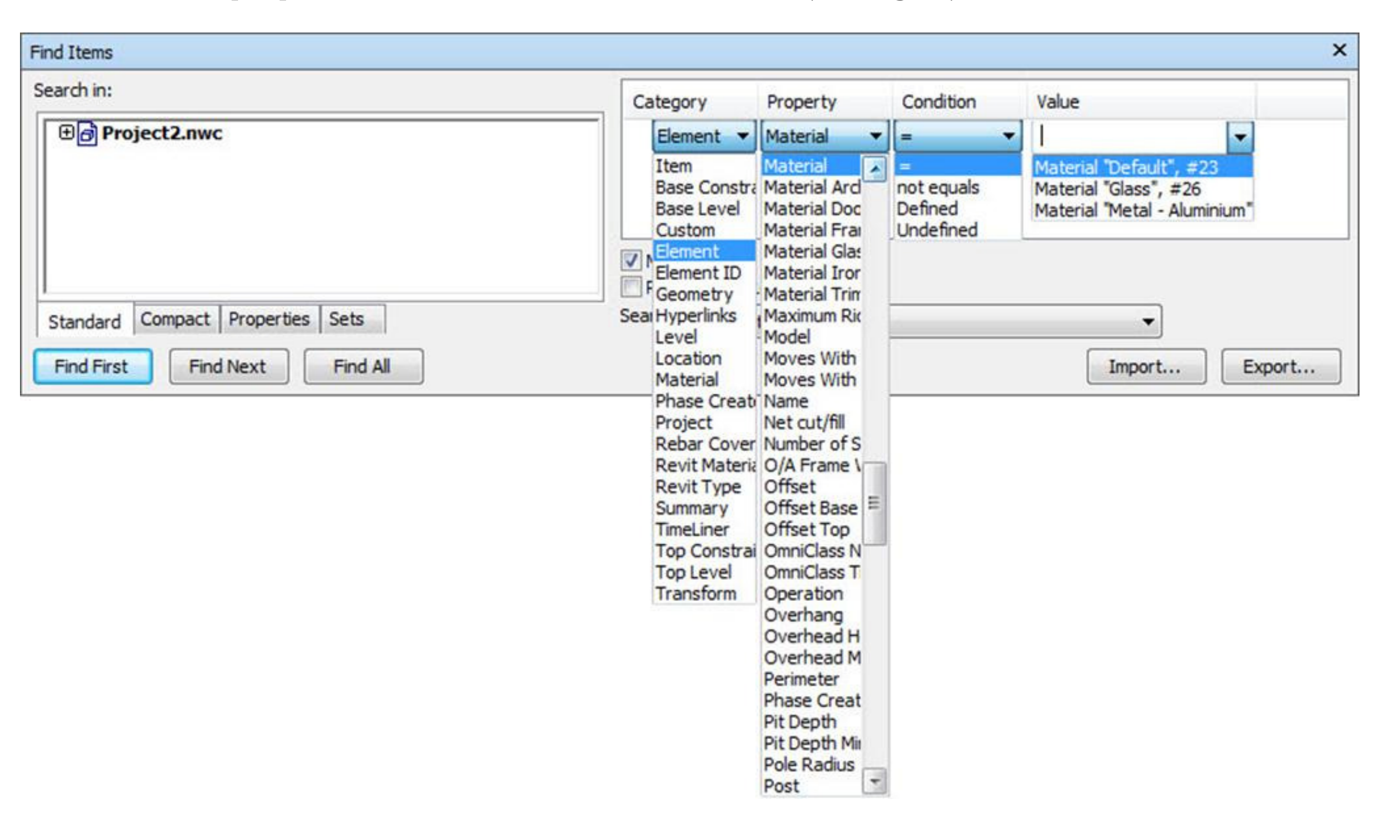


Fig.23. Model elements search dialog box

Elements that were found shall be saved as a set. Saved sets reside in the *Sets* palette (Fig.24).

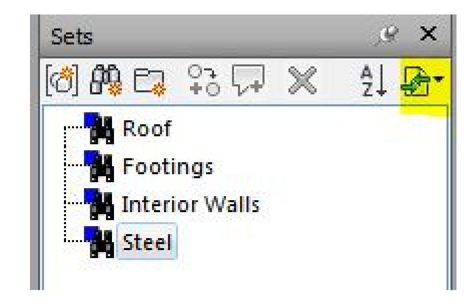


Fig.24. **Sets** palette

It's recommended to use the intelligent search sets for selecting elements during the checks. These sets, when turned to, perform the search of elements that satisfy the specified conditions.

Navisworks® supports complex search criteria based on more than one property (*OR operation,* see Fig.25). As a result, all model elements that satisfy either specified condition are being selected.

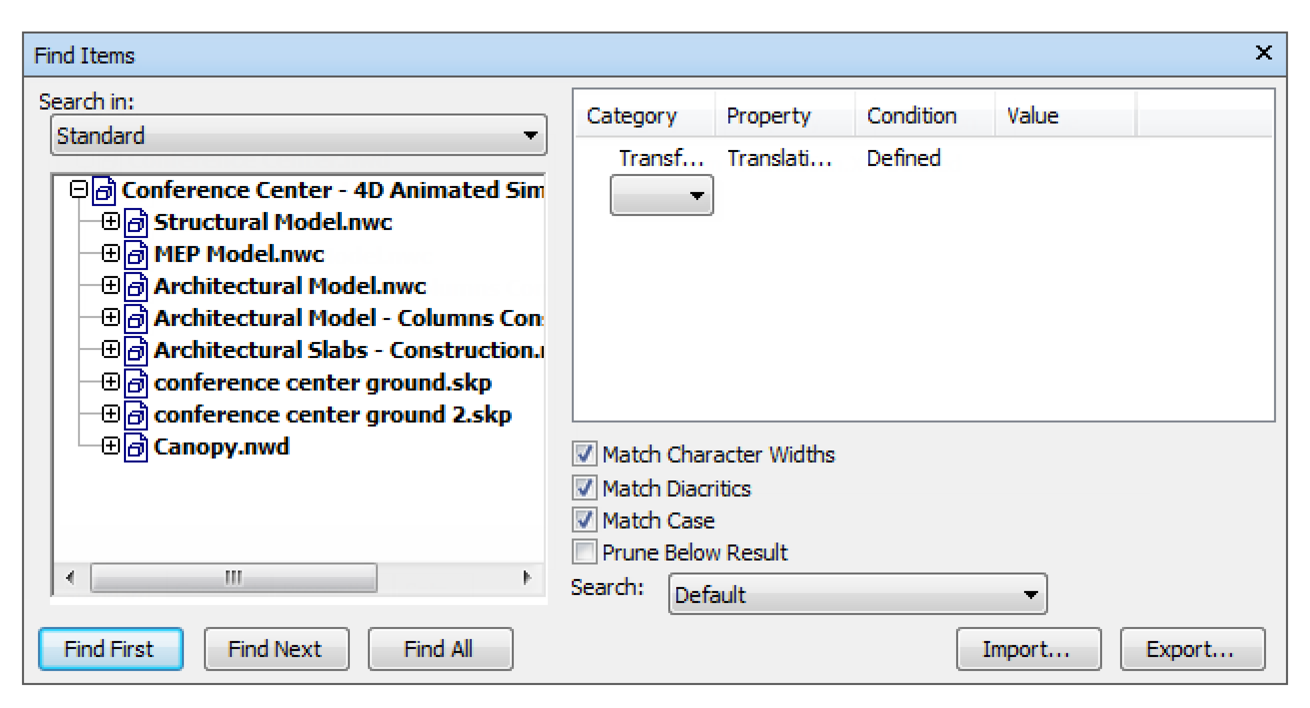


Fig.25. Creating a search criteria

WARNING! Search sets are sensitive to the property names. That's especially important in setups where Russian and English software versions are used concurrently. Sets that were created in a Russian version will not work in an English one, and vice versa.

The following recommendations shall be observed for the efficient work with the federated model in Navisworks®:

4.2.1 Setting the **Selection Resolution**

Model element search is based on the properties of elements. In order to speed up the search and selection of elements, it's recommended to activate *Set Selection Resolution To First Object* right-click menu option (Fig.26).

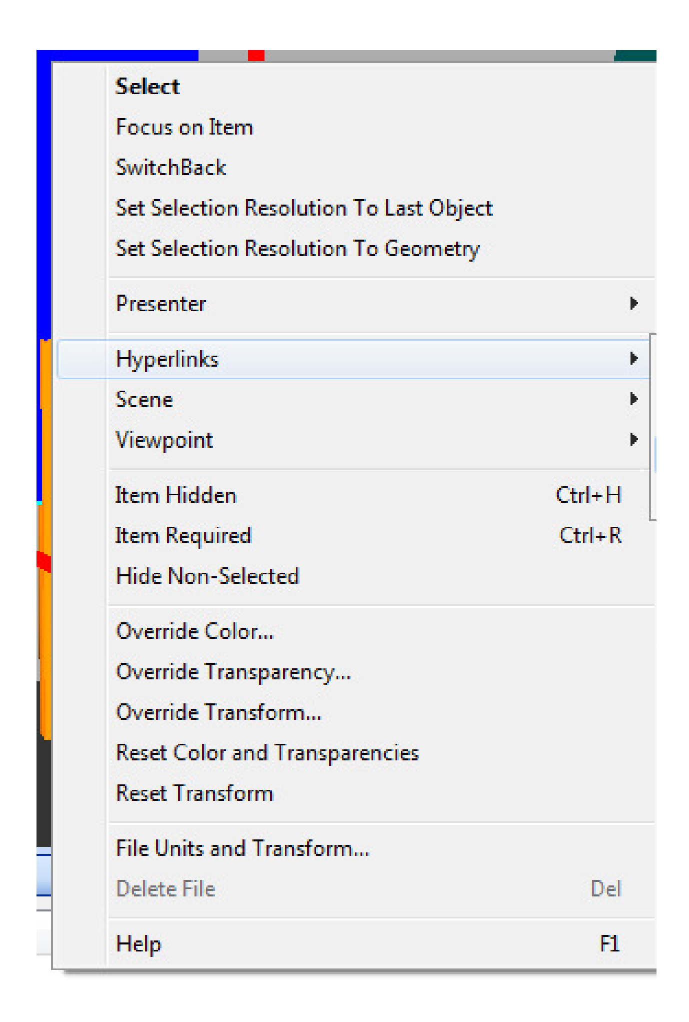


Fig.26. The right-click element selection menu

Such a setting ensures display of the maximum number of properties in the *Properties* window after selecting an element (Fig.27).

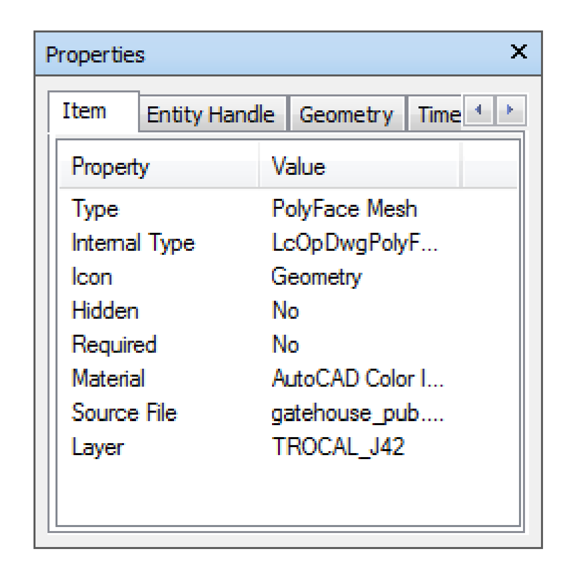


Fig.27. The selected element properties window

5 Visual Check for Design Errors

5.1 Searching for design errors

The visual check shall be carried out by means of the federated model walk-through and fly-by using the navigation, section and measurement tools. Clashes that have been found shall be documented using the review tools.

It is recommended to use the *Lock* option for better measurement accuracy (Fig.28).

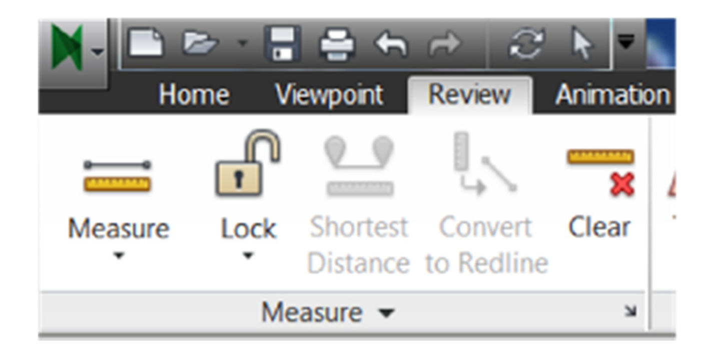


Fig.28 Locking during the measurements

Using the *Appearance Profiler* tool is recommended for enhanced visual check.

5.1.1 Appearance Profiler

The *Appearance Profiler* tool enables the visual separation of various model systems (Fig.29).

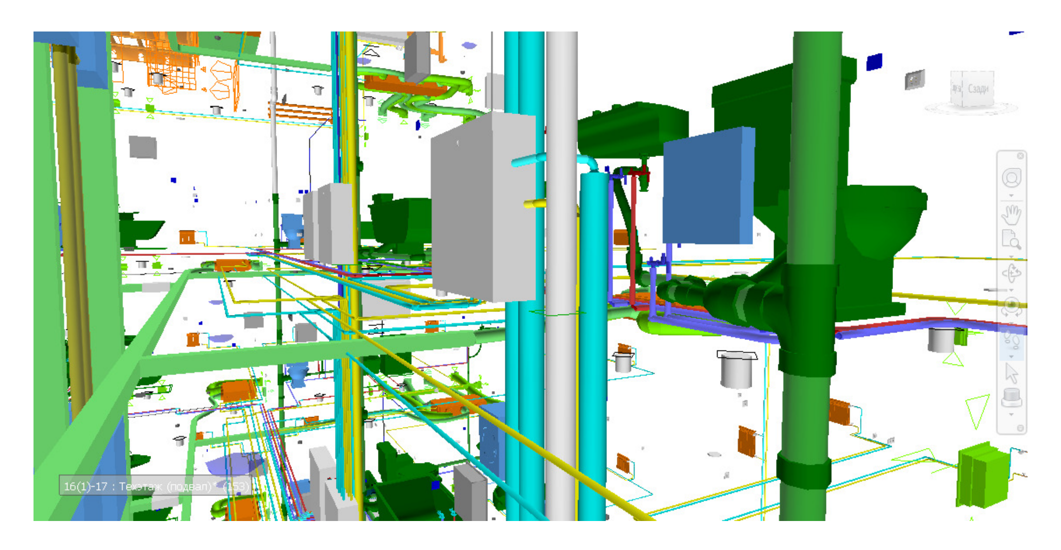


Fig.29 Color separation of building systems

The tool settings shall be saved in a separate DAT file, for easy *Appearance Profiler* application in other designs. That allows to standardize building systems visualization within the BIM model in a corporate level (Fig.30).

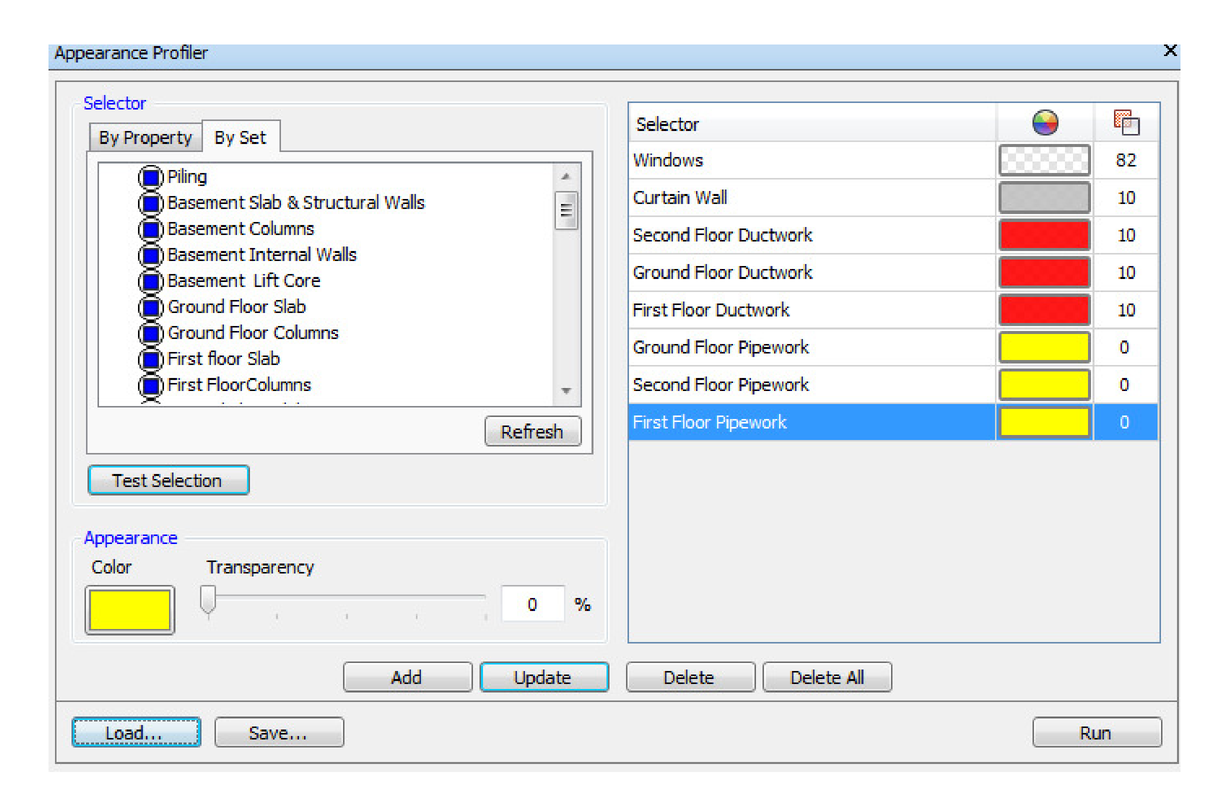


Fig.30 The Appearance Profiler dialog box

WARNING! All *Appearance Profiler* settings shall be saved before the Navisworks® session is closed. Otherwise, the settings will be lost.

5.2 Documenting the Detected Clashes

The following recommendation shall be observed:

- Notes in the model shall be created using tags that are very convenient for documenting purposes. Each tag contains the view point and a comment identifying the time/date and author.
- *Saved Viewpoints* window collects the views from all tags and allows to quickly change the view.
- Use the *Find Comments* tool (Fig.31) to search for a comment.

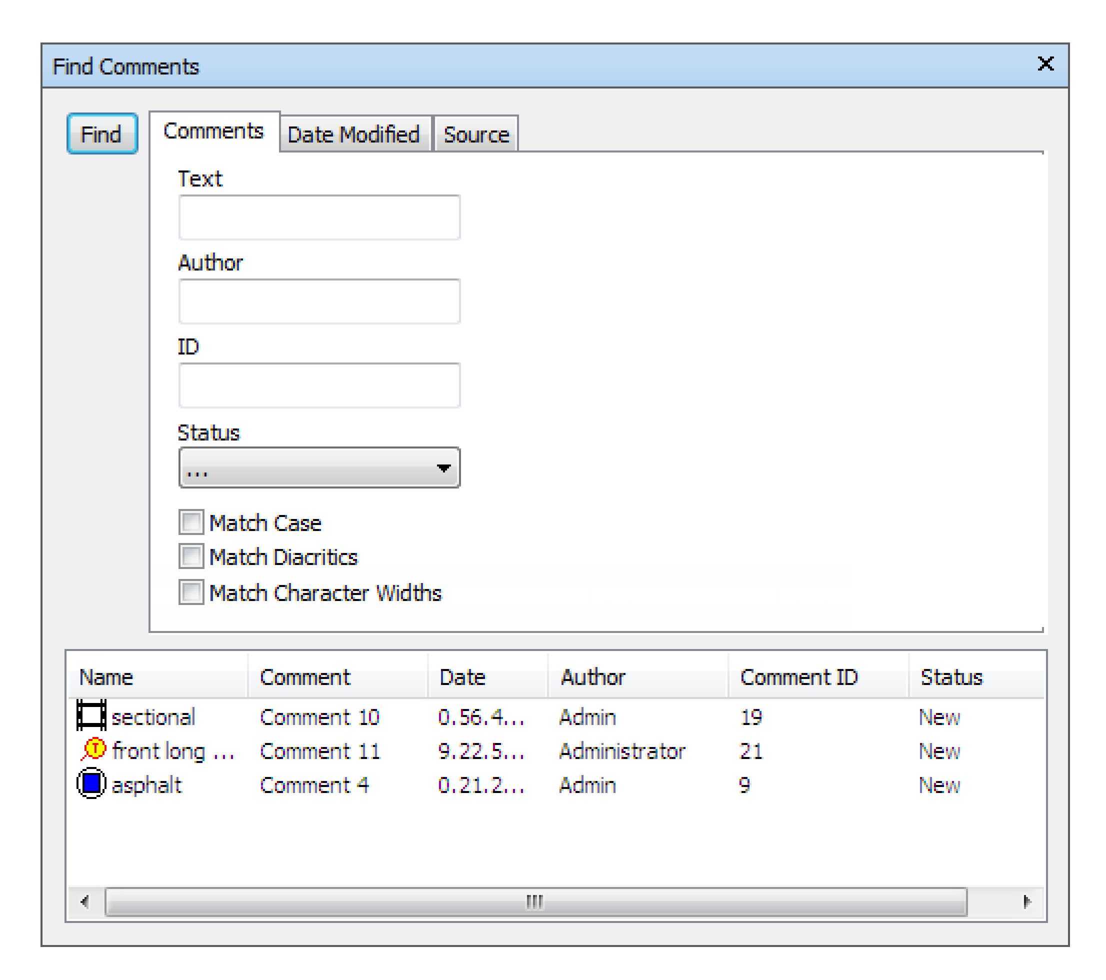


Fig.31. The Find Comments window

- Group the viewpoints into folders (Fig.32) for more efficient handling them.

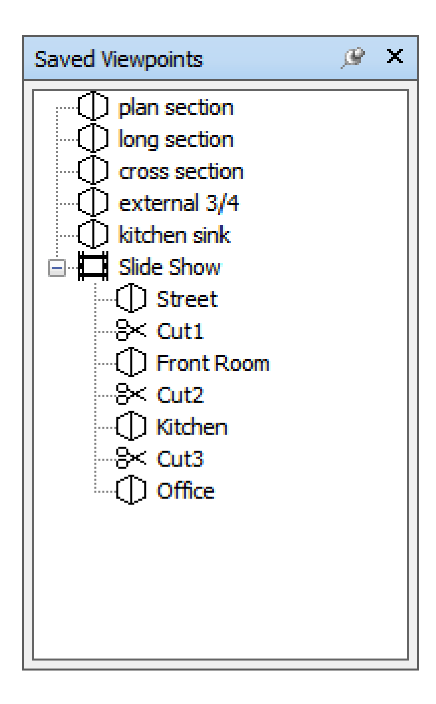


Fig.32. Grouping the saved viewpoints

5.3 Creating the Visual Design Error Check Report

Each record in the visual check report (see Appendix C, Table C.3) shall contain the viewpoint, comment, clashing element IDs and the name of a person responsible for the clash resolving.

6 Automated Check for Clashes

BIM Manager/Coordinator takes the responsibility for carrying out automated checks, notifying all stakeholders and supervising the resolution activities.

Automated clash checks are carried out in the *Clash Detective* module.

The automated check process is composed of:

- Creating a clash test
- Selecting elements for checking
- Setting test criteria and options
- Running the test
- Creating clash check reports

6.1 Creating a clash test

The test shall be created during the first launch of the *Clash Detective*. After the test is created, model element selection options become active.

6.2 Selecting elements for checking

Using the search sets is recommended for element selection. The search sets have to be created beforehand (see Fig.24) or loaded from an XML file.

An example of search sets for a clash check is shown in Fig.33.

Clash Detective

100_C_05_1001 Rail_Track Kerb - 02_Drainage_Furniture

Last Run: Friday, 28 March 2014 2:12:52 PM
Clashes - Total: 2 (Open: 1 Closed: 1)

Name	Status	Clashes	New	Active	Reviewed	Approved	Resolved
100_C_05_1001 Rail_Track Kerb - 01_ATCO_Gas_Furniture	Done	0	0	0	0	0	0
100_C_05_1001 Rail_Track Kerb - 02_Drainage_Furniture	Done	2	0	1	0	0	1
100_C_05_1001 Rail_Track Kerb - 03_Telstra_Furniture	Done	23	0	23	0	0	0
100_C_05_1001 Rail_Track Kerb - 04_Sewer_Furniture	Done	1	1	0	0	0	0
100_C_05_1001 Rail_Track Kerb - 05_Western_Power_Furniture	Old	231	231	0	0	0	0
100_C_05_1001 Rail_Track Kerb - 06_Water_Water_Corp_Furniture	Done	81	81	0	0	0	0
200_C_05_1001 Rail_Track Kerb - 01_ATCO_Gas_Furniture	Done	8	8	0	0	0	0
200_C_05_1001 Rail_Track Kerb - 02_Drainage_Furniture	Done	131	131	0	0	0	0
200_C_05_1001 Rail_Track Kerb - 03_Telstra_Furniture	Done	125	125	0	0	0	0
200_C_05_1001 Rail_Track Kerb - 04_Sewer_Furniture	Done	28	28	0	0	0	0

Add Test | Reset All | Compact All | Delete All | Update All

Rules | Select | Results | Report

Selection A
Sets
05_Western_Power
06_Water
06_WIN Bores
07_Main Roads
07_Pits
07_Power Pole
10_Rail_Track_Western_Eastern
20_Rail_Track_Northern
30_Buildings
30_Clashes
30_No Longer used Services
30_Proposed service
30_Rail Car
30_Site Feature
30_Surface
99_Links
Check
99_Funiture
10_RetainingWall_Western_Eastern
20_RetainingWall_Northern

Selection B
Sets
02_Drainage_Furniture
02_Drainage_Other(Not Cross-Parallel)
02_Drainage_Parallel
03_Telstra
04_Sewer
05_Western_Power
06_Water
06_WIN Bores
07_Main Roads
07_Pits
07_Power Pole
10_Rail_Track_Western_Eastern
20_Rail_Track_Northern
30_Buildings
30_Clashes
30_No Longer used Services
30_Proposed service
30_Rail Car
30_Site Feature
30_Surface

Settings
Type: Clearance Tolerance: 0.50 m
Link: None Step (sec): 0.1
Composite Object Clashing
Run Test

Fig.33. Model element selection for checking

6.3 Setting test criteria and options

Test criteria are set in the lower left-hand part of the *Clash Detective* window (Fig.34).

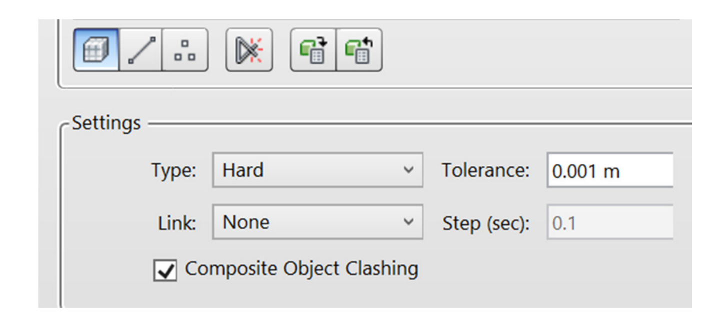


Fig.34. Setting the test criteria

In the figure, (1) defines the scope of check; (2) describes the method of check.

The minimum required parameter set for checking includes:

- – Selection of surfaces as part of the geometry to be checked.

- Type:
  - **Hard:** two objects spatially intersect. **Tolerance** represents the depth of intersection. If the depth lies within the tolerance value, then it is assumed that the clash can be resolved on-site, and there is no impact on schedule and budget.
  - **Clearance:** while the two objects do not physically intersect, the clearance zones around them overlap. Detection of such kind of clashes is especially important when, for instance, insulation around pipes and ducts has to be taken into account.
    Tolerance represents the thickness of the insulation layer.
  - **Duplicates:** two objects are identical both in type and position.
- **Tolerance:** depth of intersection or thickness of the clearance zone around an element (see above). Depends on the type of check.

6.4 Running the test

After the elements to be checked are selected and criteria are set, the test shall be run by clicking the *Run Test*.

Subsequent tests can be initiated from the *Results* tab by clicking the *Re-run Test* (Fig.35).

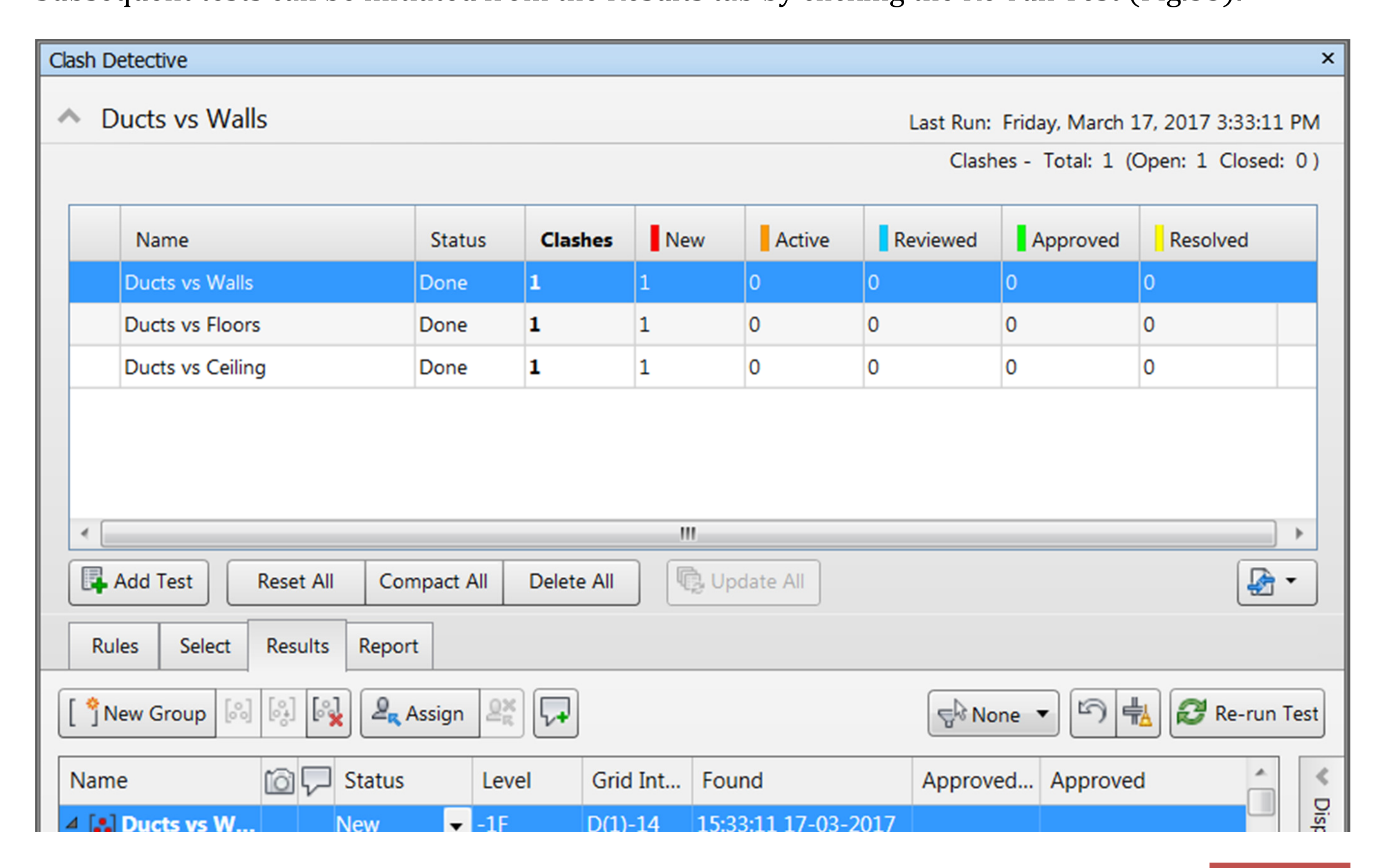


Fig.35. Clash Detective window, Results tab

6.5 Creating the Automated Clash Check Report

6.5.1 Check Results

The list of detected clashes and their statuses is displayed in the *Results* tab (Fig.36).

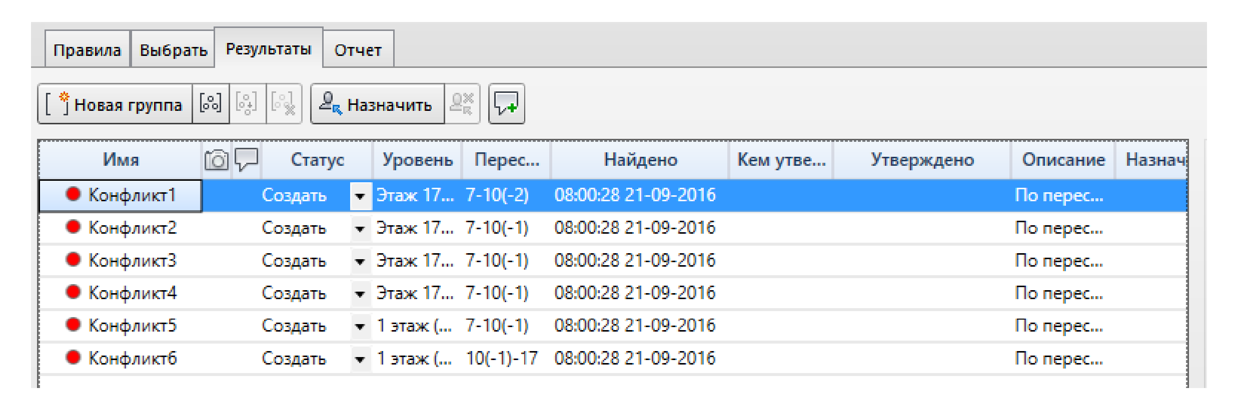


Fig.36. List of clashes found during the clash check

Each clash may have one of the following status values:

- **New:** clash gets this status during the very first check.
- **Active:** clash has not been resolved by the moment of test re-run.
- **Resolved:** clash has been resolved by the moment of test re-run. The *Compact* command removes the resolved clashes from list.
- **Reviewed:** relates to assignment of a responsible for resolution.
- **Approved:** actually this is not a clash. Name of approver, date and time of approval are displayed.

Reviewed and approved clashes are automatically moved to the end of list (Fig.37).

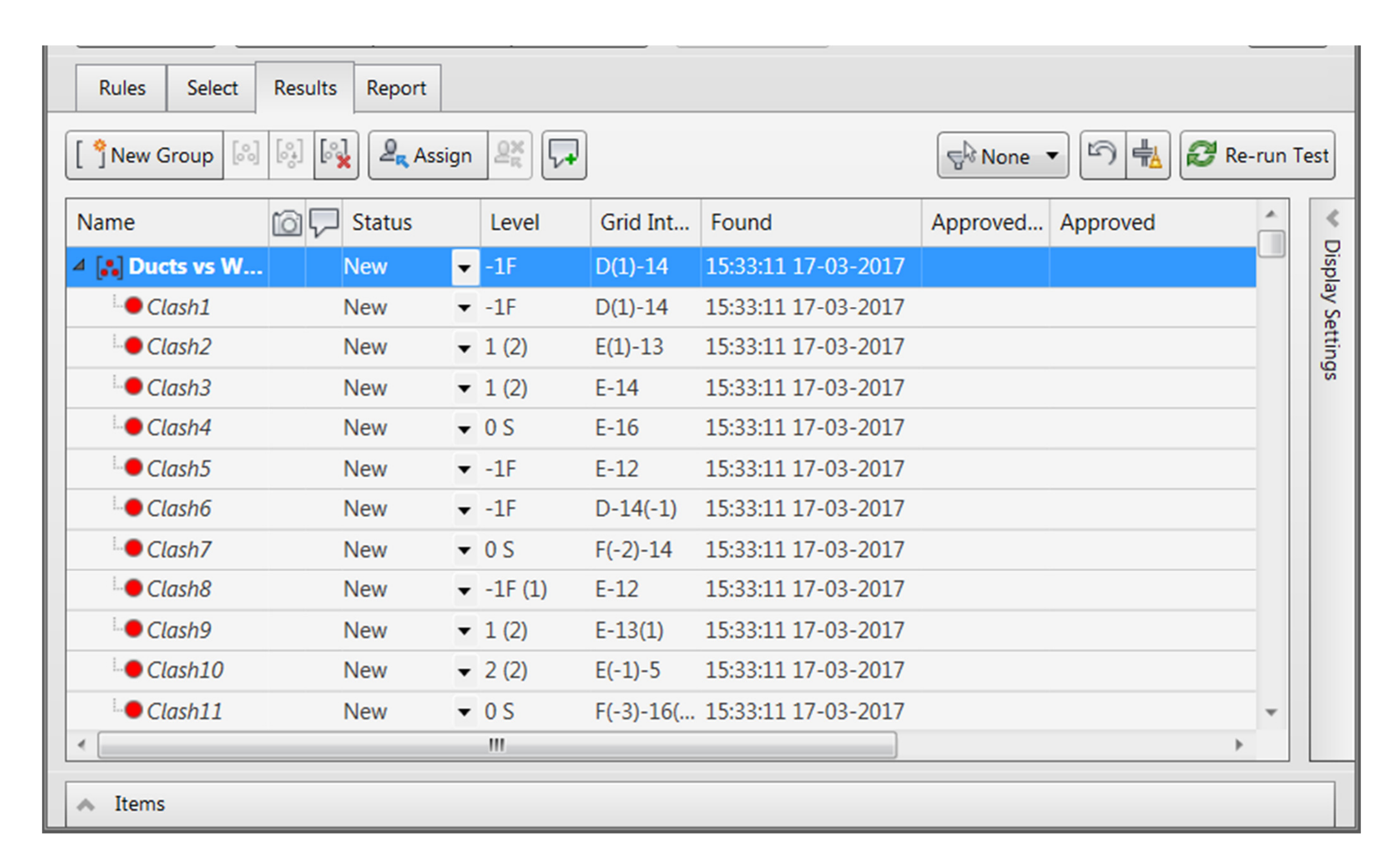


Fig.37. Clash statuses

6.5.2 Creating the Report

The report is generated on the *Report* tab in *Clash Detective* (Fig.38).

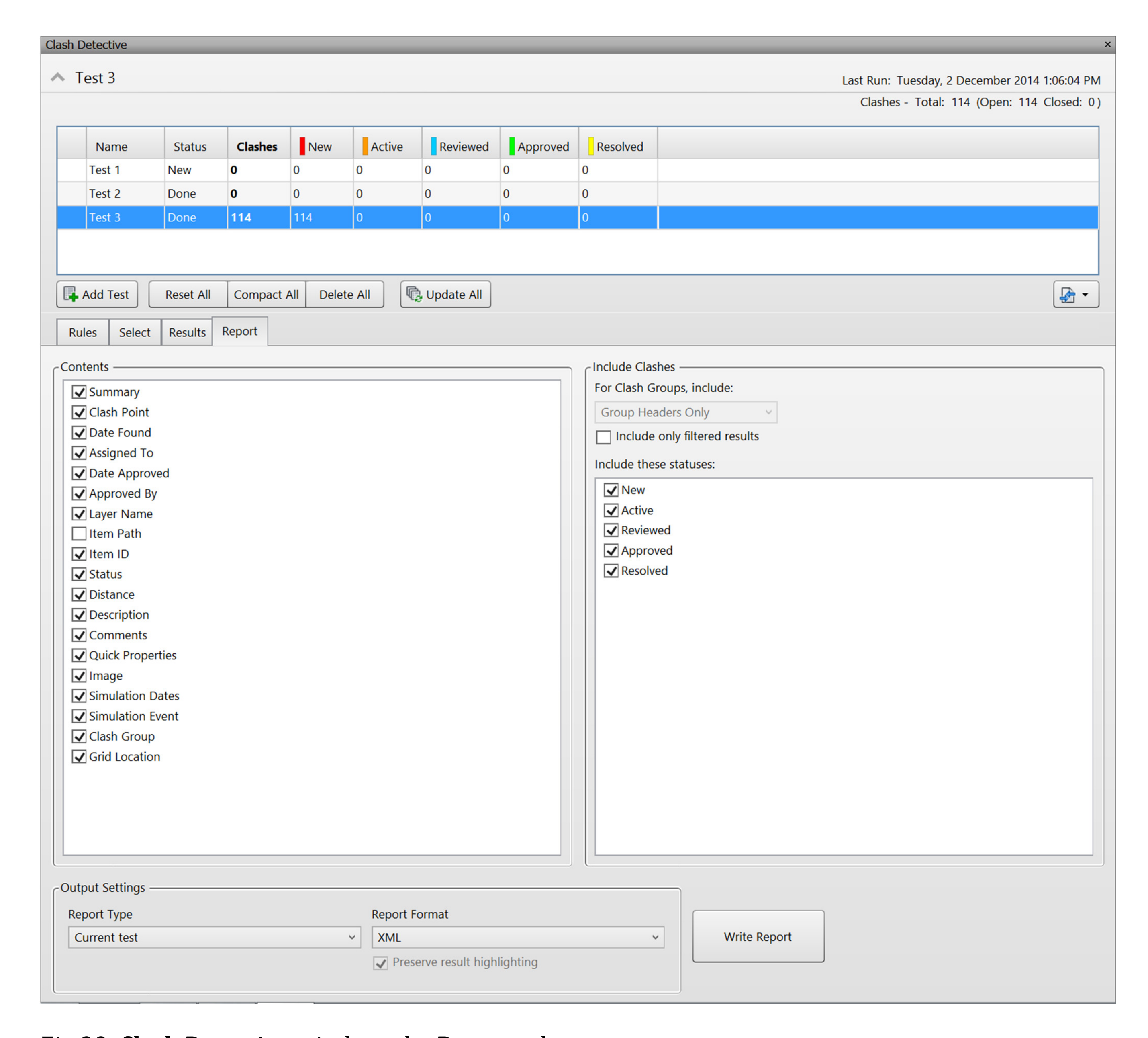


Fig.38. **Clash Detective** window, the **Report** tab

A sample automated clash check report form is shown in Appendix C, Table C.1.

The clash resolving progress may be traced in the summary report (see Appendix C, Table C.2).

7 Clash Analysis

The following recommendations shall be observed during the clash analysis:

- Grouping clashes (Fig.39) makes the clash management more efficient.

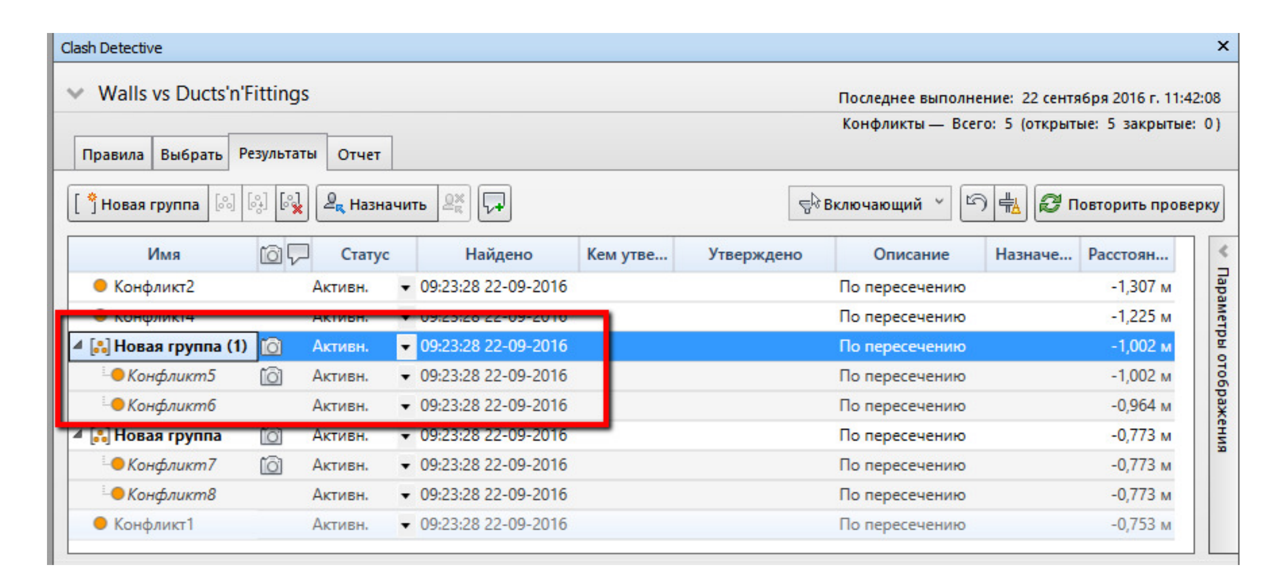


Fig.39. Grouping clashes

- Using the *Inclusive* option of the *Filter by Selection* tool (Fig.40) speeds up the clash analysis and their grouping.

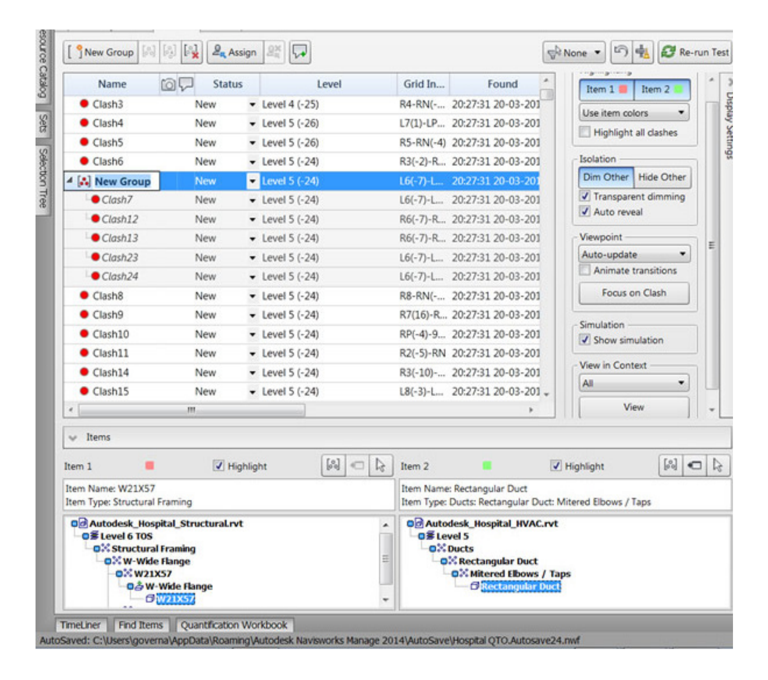


Fig.40 Filtering with the **Inclusive** option

The *Inclusive* option limits the displayed list: only clashes that involve the selected element are shown. You may include such clashes into groups and handle them (e.g. change status and responsible person) collectively (Fig.41).

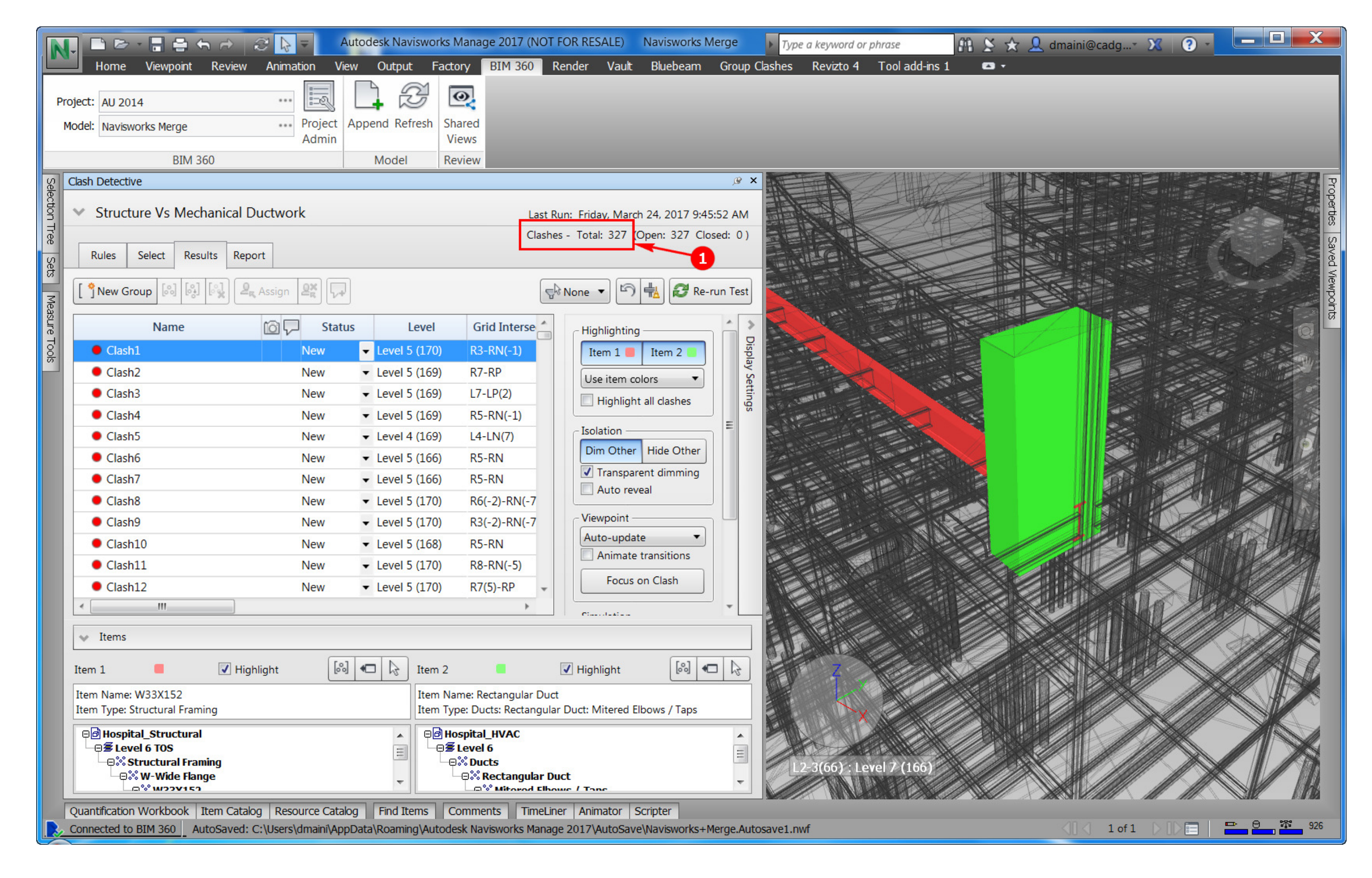


Fig.41. Selecting a group of clashes

The clash analysis process results in the assignment of people responsible for their resolution. See Appendix C, Table C.1.

8 Resolution of Detected Clashes

After the list of clashes has been reviewed and analyzed, the check results shall be handed over to the assigned responsible persons.

There are two ways of handing over the results:

- The SwitchBack tool
- Using the Item ID

8.1 The SwitchBack Tool

It's recommended to use the *SwitchBack* tool for handing over the check results. It allows to select a model element in Navisworks® and switch to the same element (setting the appropriate view) in Revit®.

Navisworks® Manage and Revit® shall be launched on the same PC. The *SwitchBack* shall be active in Revit® (Fig.42).

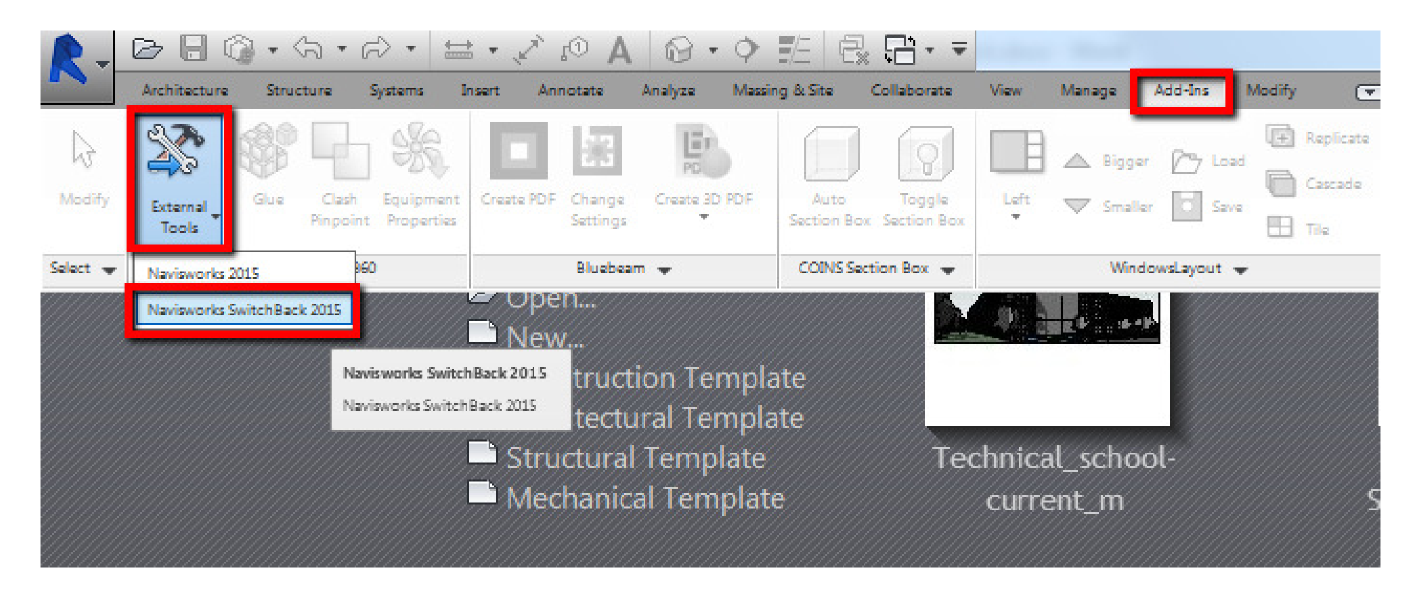


Fig.42. Activation of **SwitchBack** in Revit®

Don't forget that the perspective view is the basic one in Navisworks®. After switching to Revit®, the perspective view is created/set, however such a view is not a working one in Revit®.

That's why you need to set an orthographic view in Navisworks® before using *SwitchBack*.

8.2 Using the Item ID

The element's Item ID is unique in the design, and it is often used for the quick search purposes.

Navisworks® displays Item IDs in the clash check report(Fig.43).

Autodesk®
Navisworks®

Clash Report

Test 1	Tolerance	Clashes	New	Active	Reviewed	Approved	Resolved	Type	Status
	0.00ft	19	19	0	0	0	0	Hard	OK

Image	Clash Name	Status	Distance	Description	Date Found	Clash Point
	Clash1	New	-0.12	Hard	2012/7/30 14:15.53	x:1.50, y:-0.00, z:2.28
	Clash2	New	-0.07	Hard	2012/7/30 14:15.53	x:5.21, y:3.09, z:2.52
	Clash3	New	-0.07	Hard	2012/7/30 14:15.53	x:5.21, y:3.09, z:2.52

Fig.43. Item ID in the clash check report

The element can be found in Revit® by its Item ID.